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# THE UNCERTAINTY EFFECT ON SAVING DECISIONS. AN EMPIRICAL ANALYSIS FOR THE SPANISH ECONOMY

Alba Lugilde Sánchez

**ESCOLA DE DOUTORAMENTO INTERNACIONAL**

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**The uncertainty effect on saving decisions. An empirical analysis for the Spanish economy**

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**The uncertainty effect on saving decisions. An empirical analysis for the Spanish economy**

Dna. Dolores Riveiro García
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A mi gran familia,
por ser lo más importante
en mi día a día.

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Escribir una tesis requiere una gran inversión de tiempo, es un proceso de aprendizaje en el que te das cuenta de lo mucho que te falta por saber. Y es también una etapa en la que la gente que te rodea es parte del fruto que obtienes. A todos vosotros, que de un modo u otro habéis contribuido al resultado final, quiero daros las gracias.

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# ABSTRACT

This thesis analyses whether there is an effect of uncertainty on the consumption and saving decisions of Spanish families, generating saving by precautionary motive. Issues related to the decision-making in contexts of uncertainty have become particularly relevant in recent years, in which financial, economic and political turmoil caused an increase in uncertainty about the future income of households.

Although the precautionary saving hypothesis has been contrasted in a large number of works, both at macroeconomic and microeconomic level, the empirical results are not conclusive. No consensus has been reached on the intensity of this motive for saving nor on which is the most appropriate measure of uncertainty. The thesis offers, in the first chapter, a review of the literature that empirically addresses the existence of precautionary saving. The general conclusion drawn from this review is that uncertainty affects consumption and savings decisions, although not all the uncertainty measures that can be used are appropriate for all countries or in all macroeconomic contexts. This is also the result achieved in the analysis carried out for the Spanish case.

The thesis assesses, in chapters two and three, the effect of uncertainty on consumption/savings decisions of Spanish households, through empirical analysis with data from the Survey of Household Finances. On the one hand, using cross-sectional data we construct several uncertainty measures commonly used in the literature, as well as an additional indicator based on data on job insecurity. On the other hand, by exploiting the panel component of the survey, we construct a measure of income variability, which is the proxy for the uncertainty most commonly used in empirical works. In both analysis we obtain evidence in favour of the precautionary saving hypothesis.

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# RESUMEN

Esta tesis analiza si hay un efecto de la incertidumbre sobre las decisiones de consumo y ahorro de las familias españolas, generando ahorro por motivo precaución. Las cuestiones relacionadas con la toma de decisiones en contextos de incertidumbre han cobrado especial relevancia en los últimos años, en los que la agitación financiera, económica y política provocó un aumento de la incertidumbre sobre la renta futura de los hogares.

Aunque la hipótesis de ahorro precaución ha sido contrastada en un gran número de trabajos, tanto a nivel macroeconómico como microeconómico, los resultados empíricos no son concluyentes. No se ha llegado a un consenso sobre la intensidad de ese motivo para el ahorro, ni sobre cuál es la medida de incertidumbre más adecuada. La tesis ofrece, en el primer capítulo, una revisión de la literatura que ha abordado empíricamente la existencia de ahorro precaución. La conclusión general que se extrae de dicha revisión es que la incertidumbre afecta a las decisiones de consumo y ahorro, aunque no todas las medidas que se pueden utilizar para aproximar la incertidumbre son adecuadas para todos los países o en todos los contextos macroeconómicos. Este es también el resultado alcanzado en los análisis que realizamos para el caso de España.

En la tesis se evalúa, en los capítulos dos y tres, el efecto de la incertidumbre sobre las decisiones de consumo/ahorro de los hogares españoles, a través de análisis empíricos con datos de la Encuesta Financiera de las Familias. Por una parte, usando datos de corte transversal, construimos diversas medidas de incertidumbre, empleadas habitualmente en la literatura, así como un indicador adicional basado en datos de precariedad laboral. Por otra parte, explotando el componente de panel de la encuesta, construimos una medida de variabilidad de la renta, que es la proxy de incertidumbre más comúnmente utilizada en los trabajos empíricos. En ambos análisis obtenemos evidencia a favor de la hipótesis del ahorro precaución.

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# RESUMO

Esta tese analiza se hai un efecto da incerteza sobre as decisións de consumo e aforro das familias españolas, xerando aforro por motivo precaución. As cuestións relacionadas coa toma de decisións en contextos de incerteza cobraron especial relevancia nos últimos anos, nos que a axitación financeira, económica e política provocaron un aumento da incerteza sobre a renda futura dos fogares.

Aínda que a hipótese de aforro precaución foi contrastada nun gran número de traballos, tanto a nivel macroeconómico como microeconómico, os resultados empíricos non son concluíntes. Non se ten chegado a un consenso sobre a intensidade dese motivo para o aforro, nin sobre cal é a medida de incerteza máis axeitada. A tese ofrece, no primeiro capítulo, unha revisión da literatura que ten abordado empiricamente a existencia de aforro precaución. A conclusión xeral que se extrae desta revisión é que a incerteza afecta ás decisións de consumo e aforro, malia que non tódalas medidas que se poden empregar para aproximar a incerteza son axeitadas para tódolos países nin en tódolos contextos macroeconómicos. Este é tamén o resultado alcanzado nas análises que realizamos para o caso de España.

Na tese avalíase, nos capítulos dous e tres, o efecto da incerteza sobre as decisións de consumo/aforro dos fogares españois, a través de análises empíricas con datos da "Enquisa Financeira das Familias". Por unha parte, empregando datos de corte transversal, construímos diversas medidas de incerteza, empregadas comunmente na literatura, así como un indicador adicional baseado en datos de precariedade laboral. Por outra parte, explotando a compoñente de panel da enquisa, construímos unha medida de variabilidade da renda, que é a proxy de incerteza máis comunmente empregada nos traballos empíricos. En ambas análises obtemos evidencia a favor da hipótese do aforro precaución.

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# GENERAL INTRODUCTION

One of the main consequences of the economic and financial crisis in recent years is the increase in the levels of macroeconomic uncertainty (reflected, for example, in the volatility and variability of the macroeconomic projections made by international institutions: OECD, European Commission, IMF, etc.) which, in turn, cause volatility in the microeconomic decisions of private agents, mainly those related to consumption and investment. Since the precautionary motive for saving arises in uncertainty contexts, this topic has been of especial interest over the last years, when financial, economic and political turmoil increased uncertainty about future income and thus affected household decisions on consumption and saving.

In the case of the Spanish economy, the large decline in household consumption recorded by the National Accounts is certainly related to decreases in the level of disposable income, but can also have a certain precautionary saving component. In fact, the saving rate of the Spanish economy, which had reached historical lows throughout the last expansion, began to increase noticeably in the early phases of the recession. This increase can be interpreted as a form of protection against the growing uncertainty generated by a generalized recession accompanied by increasingly high unemployment rates. Additionally, it is observed that in the most recent phases of the recession the increase in the savings rate is stagnating and has even reversed, while consumption continues to plummet. Therefore, the recent experience of the Spanish economy justifies an exhaustive analysis of the consumption patterns of households since the beginning of the recession as well as the effect of uncertainty on such patterns. The interest of this analysis is reinforced by the fact that the type of uncertainty affecting consumption decisions also affects the macroeconomic policy design.

***Objectives.*** The **main objective** of this thesis is to analyse the uncertainty effect on the consumption and savings decisions of Spanish households through an empirical analysis with microeconomic data, and to contrast the hypothesis of a precautionary motive for saving.

In achieving that objective, the thesis addresses some specific objectives. Firstly, it provides a comprehensive review of the literature on precautionary saving discussing the main controversial issues and the different approaches followed by the studies addressing empirically the test of precautionary saving in order to set the framework for the subsequent empirical analysis. This empirical analysis will enable, on the one hand, to shed light on the existence of a precautionary motive for saving in Spain. On the other hand, we will be able to identify the impact of different sources of uncertainty on consumption/savings decisions at the microeconomic level, providing evidence in favour of some of the alternative uncertainty measures discussed previously.

***Contribution.*** The main contribution of this research is to provide empirical evidence about the existence of precautionary saving in Spain. Furthermore, a comprehensive review of the empirical literature on precautionary saving is provided, which allows the identification of the most appropriate econometric approaches and uncertainty proxies to be used in the aforementioned empirical analysis. Since our econometric results show a negative impact of uncertainty on household consumption we conclude that a precautionary motive for saving exists in Spain. This is a relevant contribution because it reinforces the scant previous empirical evidence on the topic, either for Spain (Albarrán, 2000; Barceló and Villanueva, 2010, 2016; or Campos and Reggio, 2015) or for other developed countries (US, Italy, UK, Germany and few others).

***Research outline.*** The **first chapter** provides a review of the existing evidence on precautionary savings, as well as the different econometric approaches and uncertainty proxies. In the framework of the Life Cycle/Permanent Income model, a positive level of savings is a consequence of a future decline in the income pattern rationally

expected by consumers. In such case, savings is the way to optimally allocate lifelong income to lifelong consumption. When consumption decisions are made under uncertainty, and individuals are prudent and seek protection from risk, there is a significant negative impact on current consumption. So, uncertainty generates a positive extra saving, the so-called "precautionary saving". Essentially, precautionary saving is a phenomenon related to uncertainty on future income and, therefore, on future consumption possibilities, provided that the marginal utility of consumption is convex ($u'''(\cdot) > 0$). An increase in uncertainty about future income will reduce current consumption modifying the slope of the consumption pattern. Being so, the assumptions about the stochastic processes of income and rates of return, as well as the specification of the utility functions, will determine the consumption pattern. Hence, the type of risk aversion inherent in preferences is relevant to understand the impact of the future income risk on saving decisions.

Given the standard formal conditions under which a precautionary motive for saving exists, its relevance is an issue addressed mainly empirically. Depending on the data availability and the type of analysis, this theory has been tested at both macro and micro level, using wealth, consumption or saving equations and taking panel data, cross-sectional data or time series data. In spite of a rather large number of studies, empirical results are not conclusive. Most works find evidence of an effect of uncertainty on savings, but there is no consensus about the intensity of this reason for saving, nor on which is the most appropriate measure to approximate uncertainty. The latter issue actually becomes a major problem in analysing the effect of uncertainty on consumption and saving decisions. There are a large number of possible measures of uncertainty and determining which one is optimal is a difficult task. Besides finding a "good" measure at the theoretical level, the difficulties related to the availability of data or its adequacy must be added. All these dimensions (type of empirical approach, type of data, measure of uncertainty, etc.) will be taken into account in summarizing the main contributions of the empirical literature on precautionary saving.

In addition to the relevance of the precautionary motive in determining savings, it should be emphasized that the precautionary motive for saving provides a rationale for the so-called "empirical consumption puzzles". Numerous studies conclude that the permanent income hypothesis (PIH) fails in explaining the dynamics of consumption for "excess sensitivity" (Flavin, 1981) and for "excess smoothness" (Deaton 1987). Moreover, the PIH cannot explain the "excess growth" of consumption (Deaton, 1987). Despite many arguments have been raised to explain these three puzzles (such as general equilibrium considerations, consumer's myopia, the existence of liquidity constraints, etc.), none of them seems to offer as many simultaneous responses as the existence of a precautionary motive for saving.

The **second chapter** tests the precautionary savings hypothesis for a sample of Spanish households, using different subjective and objective uncertainty measures. These are constructed from the cross-sectional data from the Survey of Household Finances (EFF) and, therefore, the chapter includes a detailed description of the survey data and its methodology.

This database, has very interesting characteristics in relation to the proposed analysis, since it allows analysing the consumption/saving behaviour of Spanish families from different perspectives (levels of indebtedness, degree of precariousness in the labour market, possession of real or financial assets, etc.), all of them relevant for the quantification of uncertainty and, therefore, for the explanation of consumption patterns. The EFF is an official survey compiled by the Bank of Spain which has been run since 2002 (every three years) in order to obtain direct information about the financial conditions of the Spanish families. The survey provides information about different aspects of the economic and financial situation of Spanish households before and during the current crisis and, therefore, allows to analysing the consumption/saving patterns of Spanish households in those different contexts. It is the only statistical source in Spain that allows the linking of incomes, assets, debts and expenditure of each household. All the EFF waves have two objectives, the first one is to achieve a representative sample of the

current population with an oversampling of wealthy households and the second one is to convert part of this sample in a panel by re-interviewing households who participated in previous waves. So, the main characteristics of this Survey are the inclusion of an over-sampling of rich households and a panel component. Other important characteristic of this survey is the use of multiple imputation techniques in order to impute the missing values inherent to the income/wealth surveys.

The main feature of this chapter is the inclusion of multiple measures of uncertainty. In the existing literature each author has constructed different measures based on the specific information provided by their dataset. In this sense, our analysis reviews these measures and includes as many as possible, given our data, in the specification of an empirical consumption function. This allows for checking which of these measures are more reliable as uncertainty sources for the households included in our sample. Moreover, we construct an individual composite index of job insecurity, based on the information provided by our dataset, thus introducing a novel source of income uncertainty, the job insecurity faced by the household reference person. This individual composite index combines information on seniority, type of job arrangement (part time/full time), type of contract, number of previous employers, firm size and unemployment record. The higher the index the more vulnerable the worker is to a potential job loss, and thus we expect a fall in current consumption to increase saving as a buffer against future contingencies. To the best of our knowledge, this is the first time that a composite index of this type is introduced in a consumption equation to test the precautionary saving hypothesis.

Another feature of this analysis is that it collects data for two years (2008 and 2011), allowing thus comparisons between household consumption behaviour before and during the Great Recession. The magnitude of such recession, especially in the Spanish case, is likely to have modified the underlying consumption and saving patterns. Our results suggest that indeed this is the case, and that different uncertainty sources impact on household decisions on different moments of time.

This chapter contributes to the existing literature in three main aspects. Firstly, using a sample of Spanish households we find new evidence in favour of the existence of a precautionary savings motive. The econometric results unambiguously confirm the existence of a negative impact of uncertainty on consumption. Secondly, it is shown that depending on the specific uncertainty measure its impact on consumption is different. In general, it is found that subjective measures (based on self-perception about future household income variability) tend to generate a non-significant impact on consumption, and hence on savings. Objective measures (as the risk of losing the job, proxied by the unemployment rate, or the job insecurity that the household reference person faces) generate a significant negative impact on consumption. Finally, it is shown that the impact of these objective measures is different depending on the moment of the business cycle we are studying. Specifically, it is found that in a context of low unemployment rates, the uncertainty measured through the jobless rate exerts no impact on household consumption, whereas when it is high and rising it becomes an important source of income uncertainty, generating a large share of precautionary saving. However, when we control for time-invariant effects by estimating a fixed-effects panel data model, contrary to expectations, the unemployment rate has a significant and positive effect on consumption which casts doubts on the validity of this variable as an adequate uncertainty measure. The job insecurity measure, on the contrary, is significant at all business cycle horizons as well as in the panel specification.

The **third chapter** also analyses the existence of precautionary saving in Spain trough the effect that income uncertainty (calculated from the panel component of the EFF) has on Spanish household consumption. This chapter uses objective data from the EFF to estimate income uncertainty so that the analysis is framed in the empirical works which proxy income uncertainty using observed life-cycle income variation and the variability of income (Kazarosian, 1997; Carroll and Samwick, 1998; Guariglia, 2001; Ventura and Eisenhauer, 2006).

The main contribution of the chapter is to provide evidence about precautionary saving in Spain proxying the household income uncertainty through the household income variability. This proxy of uncertainty is derived, using the panel component of the survey, from the individual data on household income during a period of 8 years and is then used to analyse the effect the income uncertainty has on household consumption in 2014.. The analysis is performed in two steps. In a first step a measure of income risk based on panel data from 2007 to 2014 is estimated. In particular, the average household real income is calculated over the period as well as its standard deviation for each household, as proxies of household normal income and income uncertainty, respectively. Related to this it is shown that this measure correlates with some variables that are commonly thought to be related to risk, as self-employment, age, etc. In a second step, the variable of income uncertainty is related to consumption, testing whether uncertainty affects household consumption in 2014, the last available year of the survey.

So that, to the best of my knowledge, is the first time providing evidence about precautionary saving in Spain measuring income uncertainty from observed household real income data during a period of time. The results show that an increase in income uncertainty will decrease household consumption and that the magnitude of that decrease weakly differs depending on the consumption variable used as dependent variable in our model. When using the logarithm of the household consumption we obtain that an increase of 1% in the income uncertainty will decrease consumption in about 7%, however using the ratio between consumption and average income the effect is lower, given the average normal income and consumption in the sample, consumption will decrease by 5%.

Finally, we conclude with a summary of the key findings and policy implications as well as some future research lines.

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# 1. THEORY AND EVIDENCE ABOUT PRECAUTIONARY SAVING[1]

## 1.1. INTRODUCTION

This chapter provides a comprehensive review of the theoretical and empirical literature on precautionary saving. Since the precautionary motive for saving arises in uncertainty contexts, this topic has been of especial interest over the last years, when financial, economic and political turmoil increased uncertainty about future income and thus affected household decisions on consumption and saving.

In the framework of the Life Cycle/Permanent Income model, a positive level of savings is a consequence of a future decline in the income pattern rationally expected by consumers. In such case, savings is the way to optimally allocate lifelong income to lifelong consumption. When consumption decisions are made under uncertainty, and individuals are prudent and seek protection from risk, there is a significant negative impact on current consumption. So, uncertainty generates a positive extra saving, the so-called "precautionary saving". Essentially, precautionary saving is a phenomenon related to uncertainty on future income and, therefore, on future consumption possibilities, provided that the marginal utility of consumption is convex ($u'''(\cdot) > 0$), (for a review of the theoretical arguments, see Leland, 1968; Sandmo, 1970, and Drèze and Modigliani, 1972). An increase in uncertainty about future income will reduce current consumption modifying the slope of the consumption pattern. Being so, the assumptions about the stochastic processes of income and rates of return, as well as the specification of

[1] Based on this chapter a paper entitled "Precautionary Saving: a review of the empirical literature" was written. This paper is under publication process in the Journal of Economics Surveys.

the utility functions, will determine the consumption pattern. Hence, the type of risk aversion inherent in preferences is relevant to understand the impact of the future income risk on saving decisions.[2]

Given the standard formal conditions under which a precautionary motive for saving exists, its relevance is an issue addressed mainly empirically. Depending on the data availability and the type of analysis, this theory has been tested at both macro and micro level, using wealth, consumption or saving equations and taking panel data, cross-sectional data or time series data.[3] In spite of a rather large number of studies, empirical results are not conclusive. Most works find evidence of an effect of uncertainty on savings, but there is no consensus about the intensity of this reason for saving, nor on which is the most appropriate measure to approximate uncertainty. The latter issue actually becomes a major problem in analysing the effect of uncertainty on consumption and saving decisions. There are a large number of possible measures of uncertainty and determining which one is optimal is a difficult task. Besides finding a "good" measure at the theoretical level, the difficulties related to the availability of data or its adequacy must be added. All these dimensions (type of empirical approach, type of data, measure of uncertainty, etc.) will be taken into account in summarising the main contributions of the theoretical and empirical literature on precautionary saving.[4]

In addition to the relevance of the precautionary motive in determining savings, it should be emphasised that the precautionary motive for saving provides a rationale for the so-called "empirical consumption puzzles". Numerous studies conclude that the permanent income hypothesis (PIH) fails in explaining the dynamics of consumption for "excess sensitivity" (Flavin, 1981) and for "excess smoothness" (Deaton 1987). Moreover, the PIH cannot explain the "excess growth" of consumption (Deaton, 1987). Despite many

[2] Pratt (1964) is the seminal reference for the theory of risk aversion.
[3] Although references to works using macroeconomic data are included, this chapter is focused mainly on studies using microeconomic data.
[4] A review of the literature on the evidence of precautionary savings using exclusively U.S. data is provided by Browning and Lusardi (1996). They also provide a wide review of the theoretical literature.

arguments have been raised to explain these three puzzles (such as general equilibrium considerations, consumer's myopia, the existence of liquidity constraints, etc.), none of them seems to offer as many simultaneous responses as the existence of a precautionary motive for saving.

This chapter is organised as follows. Section 1.2 briefly presents the theoretical framework underlying the existence of precautionary saving. Section 1.3 summarises the rationale provided by precautionary saving for the different consumption puzzles found in empirical works, while Section 1.4 reviews the empirical literature on the topic. Finally, Section 1.5 concludes.

## 1.2. THEORETICAL FRAMEWORK

In academic research savings are defined as the residual between disposable income and total current consumption, as done by National Accounts. Then, the saving theory is in fact the consumption theory and, therefore, from a theoretical point of view, the determinants of savings should be the same that those of consumption. Thus, to pave the way for the analysis of precautionary saving, in this section we briefly present the standard consumption theory and its developments.[5]

In the 1950s, after the empirical evidence showed that the Keynesian view was inconsistent with a number of issues both at micro and macro level (see *inter* alia Kuznets, 1946; Katona, 1949), Modigliani and Brumberg (1954), Ando and Modigliani (1963) and Friedman (1957) introduced the Life Cycle Hypothesis (LCH) and the Permanent Income Hypothesis (PIH), respectively, providing the microeconomic foundation for the macroeconomic consumption function proposed by Keynes (1936). This was the origin of the "new" theory of consumption, which replaced the "fundamental psychological law" of Keynes, and in which the consumption and savings decisions of individuals are part of an intertemporal decision

[5] Attanasio (1999) and Attanasio and Weber (2010) provide a comprehensive survey of the standard model of the consumption/saving decisions.

process: trying to maximise the utility deriving from his/her entire life's consumption, the consumption of an individual in a particular period depends on the income throughout all his/her life (taken as certain) and on his/her wealth.[6]

The solution to the standard consumer's intertemporal optimization problem is an Euler equation showing that individuals wish to smooth their consumption over time.[7] In this context, saving is future consumption; a positive level of savings is motivated by the fact that consumers rationally expect a future decline in their income pattern. If consumption follows the behaviour assumed in the PIH, savings should increase when income is high relative to average income (i.e., when the transitory income is high), while they should be negative when current income is lower than permanent income.[8]

Hall (1978) was the first author in estimating the first-order condition of the intertemporal optimization problem (a consumption Euler equation) adding the rational expectations hypothesis to the consumption model. He proposed a model where consumers

[6] Although the standard Life Cycle Model of saving decisions is widely used in the literature, there is an increasingly developed alternative approach stemming from the behavioural economics. Behavioural models of savings consider that individuals do not decide how much to save in order to smooth consumption over time by solving in each period the standard optimization problem as economist would suggest; for several reasons. Essentially, they consider that, in general, households have not the ability to solve the hard dynamic optimization problems and compute the correct saving rate. This problem would be partly solved by a greater level of financial literacy. There is a growing literature relating financial decisions, particularly savings, and the financial literacy level of individuals (an overview in Lusardi and Mitchell, 2014). But, even being able to compute the optimal consumption-saving plan, households may not have sufficient willpower to execute this plan: households might lack the *"self-control"* to reduce current consumption in favour to future consumption, showing also a tendency to *"procrastination"* (Thaler, 1994; Laibson, 1997; Thaler and Benartzi, 2004; Gul and Pesendorfer, 2004). This chapter is focused on precautionary saving by prudent individuals who try to protect themselves against the future risk and do not deal with the literature focused on that alternative approach on saving.

[7] What the equation really shows is that individuals try to keep the marginal utility of expenditure constant over time; but since expenditure and the marginal utility of expenditure are monotonically related, this leads to smoothing of consumption.

[8] The temporal distribution of income is not relevant for consumption, but is relevant for savings. While consumption in one period is a function of current, previous and future income, savings are defined as the difference between current income and current consumption.

maximize expected utility and seek to keep constant the expected marginal utility of consumption. Hall assumes a quadratic utility function (i.e., the third derivate of utility function is zero, $u'''(\cdot) = 0$), which corresponds to analysing the so-called *certainty-equivalence case* (CEQ). This implies that agents take the same consumption decisions under both certain and uncertain income. In addition to the quadratic utility function assumption, the CEQ model considers other restrictive assumptions: additivity over time for the utility function and absence of liquidity constraints. After Hall's seminal contribution, a large number of works explored the PIH under rational expectations (see, among others, Flavin 1981; Hall and Mishkin, 1982; and Zeldes, 1989b). This literature finds that the PIH does not exactly capture consumption behaviour.[9]

Once one deviates from the certainty hypothesis and it is assumed that individuals take consumption decisions under future income uncertainty, the dynamic problem to be solved by consumers can be quite complex. The inclusion of uncertainty implies that the optimal consumption plan selected in each period may be or may not be the same than the one selected in the previous period. Temporal inconsistency, thus, becomes a central issue.

Let us consider a standard PIH consumption model, specifically a finite life model in discrete time within a context of uncertainty. Individuals maximize their expected utility over a finite interval subject to the budget constraint. Thus, the consumer's problem at period $t$ is to:

$$\max_{C_{t+j}} E_t \left[ \sum_{j=0}^{T-t} (1+\delta)^{-j} U\left(C_{t+j}\right) \right] \tag{1.1}$$

Subject to:

$$\sum_{j=0}^{T-t} \frac{1}{(1+r)^j} C_{t+j} = A_t + \sum_{j=0}^{T-t} \frac{1}{(1+r)^j} Y_{t+j} \tag{1.2}$$

[9] Rather, the empirical analysis suggests that the PIH fails in explaining the dynamics of consumption both for excess sensitivity (Flavin, 1981) and for excess smoothness (Deaton 1987). We will address this issue in Section 1.3.

where $E_t$ represents the expectation conditional on all information available at time $t$, $C_t$ is consumption, $Y_t$ is labour income, $A_t$ is nonhuman wealth, $T$ represents the time of death (the consumer is assumed to die without debts or assets, $A_{T+1} = 0$), $\delta$ is the time preference rate and $r$ is the interest rate.[10] Utility is additive, strictly increasing ($u'(\cdot) > 0$) and concave ($u''(\cdot) < 0$).

Solving the consumer's problem yields the first-order condition, or Euler equation, which has the following expression for $j = 1$:

$$U'(C_t) = \left(\frac{1+r}{1+\delta}\right) E_t[U'(C_{t+1})] \tag{1.3}$$

Assuming rational expectations, as Hall (1978), the expected value of the marginal utility of future consumption equals the marginal utility of future consumption plus an error term, which is assumed to be white noise:

$$E_t\big(U'(C_{t+1})\big) = U'(C_{t+1}) + \varepsilon_{t+1} \tag{1.4}$$

Then:

$$U'(C_t) = \left(\frac{1+r}{1+\delta}\right) U'(C_{t+1}) + \varepsilon_{t+1} \tag{1.5}$$

Under perfect certainty (the quadratic utility assumption), equation (1.5) shows the consumption smoothing that consumers aim for, which is done through savings. But in a context of uncertainty about future income, its impact on consumption can generate a different savings path.[11] Under some specific properties of the utility function, uncertainty generates a positive extra-saving, the so-called "precautionary saving". Retaining the properties of non-satiation

[10] Both the time preference rate and the interest rate can be assumed as constant among households and over time or not. For example, Benito (2006) or Chamon et al. (2013) assume the former specification, while Dynan (1993) assumes that the time preference rate is constant among households and over time but that the interest rate is different among households. Zeldes (1989b) allows each family having a different preference rate and Attanasio and Weber (2010) take the preference rate varying over time.

[11] In general we will consider uncertainty regarding future income, but uncertainty may be associated with other future exogenous variables, including interest rate, demographic variables or the environment in which individuals make their decisions (Browning and Lusardi, 1996).

($u'(\cdot) > 0$) and risk aversion ($u''(\cdot) < 0$), i.e., utility is increasing and concave, if marginal utility is convex ($u'''(\cdot) > 0$), then savings are increasing in income uncertainty, which means that there is a positive "precautionary saving" (see Leland, 1968; Sandmo, 1970; and Drèze and Modigliani, 1972; for a theoretical review).[12] Since Leland's work (1968), a large number of authors have shown that once the assumption of a quadratic utility function is dropped, income uncertainty affects consumption and saving decisions.[13]

To understand the consequences of a positive third derivative of the utility function, in a context of uncertainty, let us assume (as in Hall, 1978) that in equation (1.3) both the interest rate and the time preference rate are equal to zero ($r = \delta = 0$) and therefore the Euler equation relating consumption along consecutive periods (equation (1.3)) becomes:

$$U'(C_t) = E_t[U'(C_{t+1})] \tag{1.6}$$

If utility is quadratic ($u'''(\cdot) = 0$ ), the marginal utility ($U'(C_t)$) is linear and, therefore,

$$E_t[U'(C_{t+1})] = U'[E_t(C_{t+1})] \tag{1.7}$$

So, the Euler equation is reduced to:

$$E_t[C_{t+1}] = C_t \tag{1.8}$$

But if marginal utility is convex $u'''(\cdot) > 0$, $U'(C_t)$ is a convex function of $C_t$, so that, in this case:

$$E_t[U'(C_{t+1})] > U'[E_t(C_{t+1})] \tag{1.9}$$

This, in turn, implies that if $C_t$ equals $E_t[C_{t+1}]$, we have

$$E_t[U'(C_{t+1})] > U'(C_t) \tag{1.10}$$

[12] Menegatti (2001) shows that the positive third derivative of the utility function is implied by the assumption that the sign of $u'''(\cdot)$ is invariant when the level of $c_t$ changes.

[13] Leland (1968) was the first to theoretically analyze the existence of precautionary saving in a two-period model. Then, Sandmo (1970) and Drèze and Modigliani (1972) expanded Leland's two period approach, while Miller (1974, 1976) and Sibley (1975) continued the analysis in a multiperiod context.

Equation (1.10) states that a marginal reduction in $C_t$ rises the expected utility. Moreover, an increase in uncertainty increases the expected variance of consumption, which in turn implies higher expected marginal utility when it is convex, $u'''(\cdot) > 0$. When the third derivative of the utility function is positive, greater uncertainty is linked to greater savings, the current consumption level decreases (causing further growth of future consumption) and the extra saving is precautionary saving (Dynan, 1993). Thereby, convex marginal utility implies greater consumption growth than under quadratic utility (i.e. that under the assumption of certainty equivalence, CEQ, where $u''' (\cdot) = 0$).

This consumer behaviour implying that savings are increasing with income uncertainty was dubbed as "*prudence*" by Kimball (1990). In particular, Kimball defined the term "prudence" as "the sensitivity of the optimal choice of a decision variable to risk" (Kimball, 1990, p. 54). Kimball suggests that the theory of absolute and relative prudence is akin to the theory of risk aversion by Pratt (1964), linking both concepts. The term "prudence" describes the propensity to prepare to face uncertainty; in contrast to "risk aversion", which measures how much one dislikes uncertainty and how much one would move away from if possible. Thus, the Arrow-Pratt's measures of absolute and relative risk aversion have their counterparts in the theory of choice under uncertainty in terms of absolute and relative prudence.

Kimball (1990) shows that when utility is additively separable and $u(\cdot)$ is the utility of future consumption, $-u'''(\cdot)/u''(\cdot)$ is the appropriate measure of absolute prudence ($\varphi$), measuring the strength of the precautionary saving motive just as absolute risk aversion ($\theta$), $-u''(\cdot)/u'(\cdot)$, measures the strength of risk aversion. Without taking in consideration the effects of the endogenous choice of the level of risky investment, Kimball establishes that if absolute prudence ($\varphi$) is decreasing, then labour income uncertainty will raise the marginal propensity to consume out of wealth at any given consumption level. Conversely, if absolute prudence is increasing, labour income uncertainty will lower the marginal propensity to consume out of

wealth at a given level of consumption.[14] When these absolute measures are influenced by the level of consumption (the exogenous variable in this case) relative measures of prudence ($\rho$) and risk aversion ($\gamma$), respectively, may be derived. In their works, Deidda (2013) and Blundell et al. (2014) use absolute prudence measures, while Dynan (1993) and Baiardi et al. (2013) use relative prudence measures. All of them find evidence supporting a positive precautionary saving (though we should note that the evidence found by Dynan is weak). Finally, it should be stressed that Kimball uses prudence as a measure of the intensity of the precautionary motive for saving, defining the Equivalent Precautionary Premium (EPP) as a proxy of the effect of uncertainty on consumption and saving. Carroll (1994) and Carroll and Samwick (1998), using the EPP as the uncertainty measure, both find evidence of a precautionary motive for saving.

Another part of the literature on precautionary savings, starting with the seminal works of Sandmo (1970) and Rothschild and Stiglitz (1971), has investigated saving decisions when the interest rate (i.e. the return on saving) is uncertain. This literature studies the determinants of the sensitivity of saving to the interest rate risk and shows that the existence of precautionary saving relies on the magnitude of the relative prudence index which must be higher than a threshold of 2 (Li, 2012; or Liu and Menegatti, 2017). Langlais (1995) suggests that, in general, there is no simple and direct relationship between the sensitivity of saving to interest rate uncertainty and either the value of the intertemporal elasticity of substitution (as argued by Selden, 1979), or the value of the relative risk-aversion coefficient (as stated by Rothschild and Stiglitz, 1971), but both attitudes interact, explaining this way this two *a priori* inconsistent results. In a framework of two risks (labour income and interest rate risks), Baiardi et al. (2014) provide a condition on partial relative prudence which

[14] In addition, Menegatti (2001) relates these terms (prudence and risk aversion) with the third and fourth derivatives of the utility function since $d^3U(c)/\,dc^3 > 0$ is a necessary condition for decreasing absolute risk aversion (DARA) while $d^4U(c)/\,dc^4 < 0$ is a necessary condition for decreasing absolute prudence (DAP), which implies that precautionary saving declines as individual wealth rises (Kimball, 1990).

does not refer to an exact numerical threshold but depends on the distribution of the risky variables. They show that, in the case of small risks, the sufficient conditions for positive precautionary saving are weaker than in Li (2012), who studies the same problem without introducing any assumption on risk size but assuming positive quadrant dependence between risks and concludes that "positive quadrant dependent" uncertainty about both risks raises saving if and only if "partial relative prudence" is larger than 2.

Consumption and saving decisions under the contemporaneous presence of multiple risks and background risks is another growing branch of the recent literature on precautionary saving.[15] Individuals face several sources of risks which interact with each other. Some works (Gollier and Pratt, 1996; Eeckhoudt et al., 1996) introduce an uninsurable background risk in a one-argument utility function. Others (Courbage and Rey, 2007; Baiardi et al., 2014; Baiardi et al., 2016) introduce a non-financial background risk using a two-argument utility function. This second approach allows distinguishing between those risks which affect income and those, such as health or environmental risk, which directly determine a reduction in utility due to non-financial reasons.[16]

Adding a mean-zero background risk to wealth should increase risk aversion to other independent risks. However, risk aversion is not sufficient to guarantee this. Courbage and Rey (2007), Menegatti (2009a, 2009b) and Denuit et al. (2011) show that, in a bivariate framework, precautionary saving not only depends on prudence, but also on cross-prudence (which captures the effects on utility of the interaction between the two risks) and on the size and sign of the correlation between them. All of these authors examine consumption dynamics under different assumptions on the size and distribution of environmental and consumption risks.

[15] For a description of the concept of background risk see, for instance, Eeckhoudt et al. (1996).
[16] For a more complete view of the literature of multivariate risk taking, see Eeckhoudt et al. (2007) or Courbage (2014).

Another aspect to note is that in the presence of background risks the effect of insurance on saving is modified. The existence of a non-financial background risk, such as a non-financial health or environmental risks, implies that the extra-saving due to uncertainty is positive even when future income is fully insured. The same conclusion can be applied to specific insurance against health or environmental costs. This kind of insurance removes the financial dimension of health or environmental risk but not the non-financial one. This implies that risks such as those stemming from health or the environment generate variations in the saving level even in the presence of specific insurances (Menegatti, 2009b).

Focussing on the uncertainty about future income, the consumption path will depend on the assumptions about the stochastic processes of income and rates of return, as well as on the form of the utility function. The different preference types lead to completely different reactions of consumers to uncertainty about future income. Hence, the representation of individual's saving behaviour against uncertainty is particularly sensitive to the specification of preferences (risk aversion), and thus deserves explicit attention in the design of the consumption model. In other words, the type of risk aversion considered in the preferences is important to understand the impact of income risk.

In addition to the quadratic utility function, the most common utility functions used in the literature are the constant relative risk aversion (CRRA), defined as $U(C) = (1 - \gamma)^{-1} C^{1-\gamma}$ and the constant absolute risk aversion (CARA), defined as $U(C) = -\theta^{-1} exp(-\theta C)$. As mentioned above, with the quadratic utility function (that is, $U'''(C)$ and further higher derivatives are equal to zero), consumers' utility is affected by uncertainty but their behaviour does not change in response to it. Thus, quadratic preferences yield a solution where consumers save in anticipation of declining income, but without place for risk (see, for example, Campbell, 1987). Quadratic utility function can reflect risk avoidance, but does not imply a positive precautionary demand for savings (Leland, 1968); in fact, optimal savings would not be affected by the degree of uncertainty. However, in some works the assumption of quadratic

preferences is made to produce an analytical solution for consumption, since it is not possible to derive a closed form solution for consumption unless strong assumptions about the nature of uncertainty and preferences are set. In this regard, Caballero (1990) states that the use of certainty equivalence assumptions can be explained by the high degree of difficulty involved in obtaining closed-form solutions in the multiperiod optimization problem of a consumer facing a random sequence of (uninsurable) labour income shocks when the utility function is non-quadratic. Closed form solutions for optimal consumption can be obtained only in the case of the exponential utility function, where prudence is constant (Guiso et al., 1992).

The constant absolute risk aversion (CARA) preferences yield a solution that accommodates income risk (see Caballero, 1990, 1991; among others) but they have the unappealing implication that consumers react to income uncertainty in the same way whether they are rich or poor (Miles, 1997). Under CARA preferences, the adjustments for risk are linear and independent from the wealth level. Consequently, while CARA preferences allow deriving explicit solutions for the intertemporal allocation, the solutions do not represent the notion that precaution is less necessary if you are, in fact, extremely wealthy (Kimball, 1990), i.e., they do not capture rich-poor planning distinctions in a realistic way.

Consequently, quadratic preferences or CARA preferences, for which precautionary behaviour is independent from wealth levels, show serious drawbacks for the purpose of capturing precautionary saving. As a reaction to these deficiencies, Skinner (1988), Kimball (1990) and Carroll (1994), among others, study optimal consumption assuming constant relative risk aversion (CRRA) preferences, under which precautionary saving varies inversely with the initial level of wealth. The use of CRRA functions implies risk adjustments that vary with the level of consumer wealth, through the presence of terms reflecting the variance of income relative to wealth, so that they can be regarded as more realistic than the solutions for quadratic or CARA preferences. But with CRRA preferences an explicit consumption and

saving solution is not available, and hence approximations to the optimal solutions must be derived.

Despite this analytical difficulty, given that precautionary saving decreases for higher wealth levels under CRRA preferences, while being unaffected under CARA preferences, it has been suggested (e.g. Blundell and Stoker, 1999) that CRRA preferences are the most realistic for modelling saving behaviour in empirical works, since they can capture the most plausible precautionary behaviour for rich and poor households. Moreover, in the case of the CRRA function a lower level of wealth (hence of consumption) implies, *ceteris paribus*, a larger coefficient of absolute risk aversion (Caballero, 1990). We find additional arguments in the literature for the use of the CRRA utility functions. For example, Carroll and Samwick (1998) show that the choice of a CRRA utility function is preferable because it guarantees that consumers in the model will engage in precautionary saving.[17] Furthermore, as Zeldes (1989a) points out, the property of the CRRA utility, namely $u'(0) = \infty$, endogenously limits the optimal consumption to stay away from negative or zero consumption, so there is no need to impose exogenous restrictions on consumption or borrowing since the Euler equation ignores the non-negativity constraint on consumption (Zeldes, 1989b).

After this simple general summary of the theoretical framework, we will review the main contributions of the empirical literature on the evidence of precautionary savings in section 1.4. Prior to that, section 1.3 shows the contribution of the precautionary motive for saving to the explanation of the failure of the standard CEQ model in explaining the evidence on the dynamics of consumption.

[17] The coefficient of relative risk aversion $\rho$ indexes the strength of both risk aversion and prudence. With this utility function, the main necessary condition for generating a "buffer stock" saving behavior is that, if income were certain, consumers would wish to spend more than their current income. The analytical condition which guarantees this in the discrete-time version of the model with only transitory shocks to income is $(R\beta)^{-1/\rho} < G$, where $R = 1 + r$ is the gross interest rate, $\beta = 1/(1 + \delta)$ is the discount factor (being $\delta$ the discount rate) and $G = 1 + g$, being $g$ the expected growth rate of income. Under a broad range of parameter values as long as consumers are prudent ($\rho > 0$) and impatient ($\rho^{-1}\ (r - \delta) < g$) this conditions holds.

### 1.3. PRECAUTIONARY SAVING AND THE EMPIRICAL CONSUMPTION PUZZLES

The empirical literature has shown that the standard model based on the life-cycle or permanent income hypothesis does not adequately capture consumption behaviour. In particular, the empirical analysis suggests that it fails in explaining the dynamics of consumption both by excess sensitivity (Flavin, 1981) and by excess smoothness (Deaton, 1987), which are referred to as the "consumption puzzles".

The results derived from Hall (1978) out from the standard model are usually tested by regressing consumption changes on lagged consumption and income variables and testing the joint significance of the coefficients. However, several authors suggest that the statistical properties of these estimated coefficients may characterize the failure of the model. Flavin (1981), for instance, describes significant coefficients of lagged income as "*excess sensitivity*" of consumption to income.[18] She finds a strong over-response of consumption to current income in relation to the one predicted by the PIH. Flavin's test revealed substantial evidence against the PIH, which is rejected at the 5%, whereas in Hall's test it cannot be rejected at the same significance level.[19] On the other hand, changes in aggregate income are associated with relatively small changes in aggregate consumption, and deviations of consumption from its trend are smaller than those of income from its trend: aggregate consumption is "*smooth*" relative to aggregate income (Deaton, 1987). In addition, the PIH cannot explain the "persistent consumption growth even when the real interest rate has been negative" (Deaton, 1987), a property that has been dubbed as "*excess growth*" of consumption.

The textbook explanation for excess smoothness to unanticipated income changes is that consumption is determined by permanent income, which is smooth in relation to current income. Income

[18] Flavin (1981) tests the hypothesis that the consumption response to a previously anticipated change in income should equal zero. She tests for excess sensitivity to anticipated changes in income.

[19] Hall (1978) uses a broader definition of consumption (nondurable and services consumption) while Flavin (1981) uses only consumption on nondurable goods.

variations generate relatively small variations in the permanent income, and thus in consumption.[20] The PIH assumption is that consumption responds fully to permanent income shocks, while transitory shocks have marginal effects because consumers use accumulated assets to smooth temporary income fluctuations. However, there is no logical necessity for permanent income being smoother than current income. In fact, Campbell and Deaton (1989) find that there is remarkably little evidence supporting that permanent income is really smoother than measured income in aggregate data. Deaton (1987) points out the implications of these results for the consumption function, arguing that permanent income is indeed "noisier" than current income. Moreover, contrary to the predictions of the PIH theory, a common finding (Campbell and Deaton, 1989; Blundell et al., 2008) is that the marginal propensity to consume out of permanent income shocks is less than one.[21] That is, consumers partially insure against permanent income shocks (Blundell et al. 2008). Therefore, the permanent income theory does not provide any direct and well supported explanation for consumption excess smoothness relative to income.[22]

However, Deaton (1991) offers one plausible explanation for the smoothness of consumption. He argues that individuals have a great amount of personal idiosyncratic information about the likely future course of their labour income, so that even if their income path looked very noisy to an observer it would contain only some surprises for the individual. This explains why consumption would be very smooth. The consumers' extra information smooths their permanent income respect to the calculated measure of "permanent income". So, the more information consumers have, the smoother their consumption path will be.

[20] If the smoothness of consumption relative to income is taken to measure the relative variance of variations, smoothness is explained by the permanent income theory.

[21] See Jappelli and Pistaferri (2010) for a survey of the evidence on the estimates of the marginal propensity to consume out of income shocks and on the excess sensitivity tests to predicted income changes.

[22] Sluggish adjustment of consumption would reconcile all the evidence, and permanent income could be less smooth than current income without contradicting the known smoothness of consumption (Campbell and Deaton, 1989).

"Excess sensitivity" is usually inferred from the correlation between consumption changes and lagged changes in disposable income or from large regression coefficients of consumption changes on proxies for income innovations. In this sense, the results of Campbell and Deaton (1989), in line with the work of Flavin (1981), show a positive correlation between the change in consumption and lagged changes in income, a correlation that should be zero if the PIH would hold. Another interpretation, however, would be that consumption displays excessive sensitivity if it evolves too closely to income, that is, if the difference between consumption and income, or savings, varies less than the optimal forecast of discounted declines in labour income. Hall and Mishkin (1982) define excess sensitivity as the difference between the response in consumption and the annuity value of the increase in human and nonhuman wealth when an income innovation occurs as a result of it.[23]

Many additional arguments have emerged to explain these puzzles: general equilibrium considerations, myopia, liquidity constraints,[24] and different assumptions about the labour-income process, but none of these seem to provide as many simultaneous explanations as precautionary saving. A large number of papers (Hall and Mishkin, 1982; Campbell, 1987; Zeldes, 1989a; Caballero, 1990; Deaton, 1991; Carroll, 1994; and Hahm and Steigerwald, 1999, among others) show empirical evidence about the existence of precautionary savings and suggest that the precautionary motive for saving can explain these empirical puzzles. In general, these works test whether dropping the assumption of certainty equivalence can help in accounting for the excess smoothness of consumption (with respect to unanticipated changes in income) and the excess sensitivity

[23] This definition of excess sensitivity differs from Flavin's (1981).

[24] For example, Guariglia and Rossi (2002) point out that the existence of liquidity constraints is one of the most accredited explanations for the excess sensitivity of consumption to disposable income. They find that consumption changes do not exhibit "excess sensitivity" to income changes, which they interpret as indicating that the assumption that preferences are separable over time is erroneous and it might play some role in the empirical failure of the life-cycle/permanent income model. However, Zeldes (1989a) finds that consumption will exhibit excess sensitivity to transitory income and high expected growths of consumption, relative to the simple PIH benchmark, even in the absence of borrowing constraints.

(with respect to anticipated changes in income) better than the hypothesis that binding credit restrictions are the sole responsible (see Skinner, 1988; Zeldes, 1989b; and Caballero, 1990). In this sense, Zeldes (1989a) shows that there is greater sensitivity of consumption to transitory income under uncertainty than under CEQ since the result of excess sensitivity depends on higher derivatives of the utility function (moreover, excess sensitivity will occur for a class of utility functions that include CRRA and exclude CARA). Besides, Campbell and Deaton (1989) results are consistent with the assumption that consumption is smoother than it should be, given rational expectations about permanent income.

On the other hand, precautionary saving behaviour can also account, under reasonable parameter assumptions, for the "persistent growth of consumption, even when the real interest rate has been negative" (Deaton, 1987). When uncertainty is explicitly included into the model, a negative rate of time preference is not required to explain positive expected growth rates of individual consumption with low or negative real (risk-free) interest rates. This helps in solving the puzzle of how a low risk-free interest rate can be compatible in equilibrium with a high growth in aggregate consumption.[25] Caballero (1990) shows that once precautionary saving is taken into account, the excess of consumption growth puzzle is consistent with the stochastic processes of labour income estimated for the U.S. (or alternatively, given the consumption path, precautionary saving can explain the relatively low real interest rate observed in the post-war U.S. data).

From the existing empirical evidence, we can conclude that under reasonable assumptions the link between precautionary saving motives and conditional heteroscedasticity of labour income is potentially able to provide simultaneous explanations for the excess sensitivity and the excess smoothness puzzles. Under precautionary motives for saving, labour-income conditional heteroscedasticity affects the marginal propensity to consume even when the

[25] The extra growth in aggregate consumption will be a function of the uncertainty on individual income, which is significantly larger than on average aggregate income (Zeldes, 1989a).

predisposition to risk does not change with the level of wealth (as is the case with the exponential utility function, CARA) (see Zeldes, 1989a).

As we have shown above, consumers save due to precautionary reasons to protect themselves against future unexpected events and their prudent behaviour is reinforced, among other factors, by larger income risk, stronger risk aversion, weaker distaste for intertemporal substitution, higher interest rates and greater persistence of income shocks (Weil, 1993). As regards the latter, the more persistent the shocks, the greater the uncertainty faced by the individual; therefore, the persistence of income shocks magnifies precautionary saving (Guiso et al., 1992; Alessie and Lusardi, 1997; Benito, 2006; Jappelli and Pistaferri, 2006, 2011; Blundell et al., 2008; Carroll, 2009; Kaplan and Violante, 2009; or Fella et al., 2017).

In this regard, Caballero (1990) and Weil (1993) in multi-period models show that the amount of precautionary saving increases in response to an increase in the variance of the shocks of the income-generating process and in its degree of persistence. After solving the consumers problem, Weil (1993) considers the effects on consumption and savings of labour income risk, persistence, risk aversion, intertemporal substitution, and interest rates. He shows that the persistence of labour income shocks does not affect the propensity to consume out of wealth but it is a crucial determinant of the strength of precautionary savings motive. The more persistent income shocks are, the smaller the certainty equivalent of the labour income disturbance, and thus the smaller perceived human wealth, that is, more persistence in income shocks leads to a stronger precautionary savings motive.

Carroll (2009) shows that the intuition that under the PIH the rational forward-looking consumers should have a unitary marginal propensity to consume out of permanent shocks is not correct for the canonical infinite horizon perfect foresight version of the CRRA-utility optimization model, but that it is approximately correct for the "buffer-stock" version of the model, that arises when consumers are impatient and have a standard precautionary saving motive. Carroll's

simulations find that, for plausible degrees of patience and risk aversion, the marginal propensity to consume out of permanent income shocks is strictly below, but close to, one, as long as income is subject to both permanent and transitory shocks, which means that part of the permanent shocks are insured. Results obtained by Blundell et al. (2008) and Kaplan and Violante (2009) with US data also suggest that households are able to partially insure permanent shocks. Furthermore, in both studies the response to permanent shocks is significantly lower than 1: around 0.64 (higher for poor or less educated households) in the former and 0.77 (when consumers can freely borrow and save) and 0.93 (when consumers are unable to borrow) in the latter.

Jappelli and Pistaferri (2006) using data from the Italian Survey of Household Income and Wealth (SHIW) find that the marginal propensity to consume out of permanent shocks is around one, falling to a vicinity of 0.3 with respect to transitory shocks. These results are confirmed in Jappelli and Pistaferri (2011) who also point out that the marginal propensity to consume out of transitory income shocks is higher among households with lower education (0.315) than among those who completed high school (0.121), suggesting that people with higher education have easier access to credit markets to smooth income fluctuations. On the other hand, Fella et al. (2017) estimate a structural buffer-stock savings model using a panel from the SHIW, finding that Italian households can insure between 7% and 9% of a permanent income shock and between 89% and 95% of a transitory shock. Therefore, this suggests that Italian households have substantially less insurance possibilities against permanent shocks than the US counterparts, who can insure 22-36% of a permanent shock according to the estimates by Kaplan and Violante (2009) and Blundell et al. (2008).

Consumption puzzles have also been addressed through alternative hypotheses, such as the presence of internal habit formation. When there is habit formation individuals derive their utility not only from the level of current consumption but also from the comparison of this level with a reference stock determined by their

past consumption (Angelini, 2009). In a precautionary saving model with habit formation, consumption depends on past consumption, permanent income and precautionary saving. The stronger the habit, the greater the weight put on past consumption and the lower the effect of permanent income (and income shocks) and the effect of income uncertainty on consumption. Hence the presence of habit formation has a negative effect on the size of the precautionary saving. Thus, the presence of habits affects current consumption not only directly via past consumption but also indirectly making the precautionary component smaller in absolute value (see Alessie and Lusardi, 1997; or Guariglia and Rossi, 2002).

The empirical evidence using micro data is not conclusive. One of the most common approaches in micro-econometric studies used to test the presence of habit formation has been the Euler equation approach (Hotz et al., 1988; Carrasco et al., 2005; or Malley and Molana, 2006; show evidence on habit formation while Meghir and Weber, 1996; and Dynan, 2000; do not find supportive evidence). An alternative approach to the Euler equation is adopted by Alessie and Lusardi (1997), who derive closed-form solutions for consumption (and saving) under the assumption of CARA within period preferences. Guariglia and Rossi (2002) generalize Weil's non-expected utility model (1993) by allowing for habit formation and obtain a closed-form solution for saving as a function of, among other variables, lagged consumption. They find that both labour income risk and past changes in consumption are important in determining current changes in consumption. Also Alessie and Teppa (2010) results suggest that both labour income risks and past consumption changes play an important role in determining current consumption changes.

### 1.4. THE EMPIRICAL EVIDENCE ON PRECAUTIONARY SAVINGS

Following Deaton (1992), from the consumer utility optimization problem above, taking expectations of (1.2) conditional of information available at $t$, using the result that expected consumption is constant (1.8), and considering that T goes to infinity, it is possible

to define consumption $c_t$ as the present value of wealth and the expected lifetime income:

$$c_t = \frac{r}{1+r} A_t + \left(\frac{r}{1+r}\right) \sum_{j=0}^{\infty} \frac{1}{(1+r)^j} E_t\left(y_{t+j} \middle| \Omega_t\right) \qquad (1.11)$$

Where $\Omega_t$ denotes the information available at time $t$ to the individual.

As stated above, at each period $t$, saving $s_t$ is the residual between disposable income and current consumption.

$$s_t = \frac{r}{1+r} A_t + y_t - c_t \qquad (1.12)$$

Saving is future consumption; so, there is a direct link between saving decisions in the current period and expected changes in real income. In a context of uncertainty about the future, savings made by prudent individuals trying to protect themselves against risk is precautionary saving.

Empirical works on the analysis of precautionary savings differ, firstly, in the dependent variable used (in terms of equation (1.12): savings, wealth or consumption); secondly, in the choice of the uncertainty measure, and the type of data to be used; and, thirdly, in the control variables included in the empirical analysis. We next present our review of the main contributions of the empirical literature, organising the section in terms of these different dimensions (see Table 1.1 for a brief summary). Some works test the effect of uncertainty on savings in an economy, once corrected by all control variables, while others go further and try to quantify the relevance of this motive for saving or try to identify how precautionary saving is different for different groups of individuals according to their characteristics and/or the characteristics of the environment in which they make decisions.

Theoretically, the strength of precautionary motive depends on how prudent individuals are and on the degree of risk aversion they have. Therefore, we also review (in subsection 1.4.4.) another

important part of the recent empirical literature on precautionary saving: the determination of an empirical estimate of the coefficient of relative risk aversion. Starting with Dynan (1993) this has become an important issue in the empirical literature on precautionary saving.

Table 1.1. Summary of empirical papers

| Authors | Dependent Variable | Data | Sample | Uncertainty Measure | Main results |
|---|---|---|---|---|---|
| Baiardi, D., Manera, M., and Menegatti, M. (2013) | consumption growth | macro (time-series) | Canada, France, Italy, Spain, UK and USA (1965-2007) | Financial risk and environmental risk | Both financial risk alone and the interaction between financial and environmental risks affect consumption |
| Baiardi, D., Manera, M., and Menegatti, M. (2016) | consumption growth | macro (time-series) | 13 MED countries (1965-2008) | Consumption risk and environmental risk | Consumption risk raises precautionary saving in a context where environmental risk is also considered |
| Bande, R., and Riveiro, D. (2013) | saving rate and consumption growth rate | macro (time-series) | Spain (1980-2007) | Expected variance of future regional output growth and unemployment rate | Existence of an important precautionary savings motive |
| Banks, J., Blundell, R., and Brugiavini, A. (2001) | consumption growth | micro (pseudo panel) | UK (1968 - 1992) | Conditional variance of income risk using income from all sources | Evidence of a strong and increasing precautionary motive for saving |
| Barceló, C. and Villanueva, E. (2010) | financial wealth | micro (pooled) | Spain (2002, 2005) | Type of labor contract of the main recipients of income as proxy of the probability of losing employment | Evidence of precautionary saving |
| Benito, A. (2006) | consumption | micro (panel) | UK (1992-1998) | Job loss risk: subjectives probabilities and predicted probabilities from a probit model | Evidence of precautionary savings when using the predicted measure but not using the self-reported measure |
| Campbell, J. Y. (1987) | saving | macro (time-series) | USA (1953-84) | Test of the predictive power of saving for declines in labor income | PIH is worth taking seriously as a description of the broad outlines of aggregate consumption behavior |
| Carroll, C.D. (1994) | consumption | micro (panel) | USA (1968-1985) | Equivalent Precautionary Premium, standard deviation of income and variance of income | There is precautionary saving |
| Carroll, C. D. and Samwick, A. A. (1997) | wealth | micro (panel) | USA (1981-1987) | Income uncertainty descomposed into the variances of permanent and transitory shocks | Evidence of precautionary saving |
| Carroll, C. D. and Samwick, A. A. (1998) | wealth | micro (panel) | USA (1981-1987) | Equivalent Precautionary Premium and income variance | Substantial evidence that households engage in precautionary savings |
| Carroll, C., Dynan, K. and Krane, S. (2003) | wealth | micro (pooled) | USA (1983, 1989, 1992) | Estimated probability of job-loss | Precautionary saving motive only for mid-high income households. The hypothesis is rejected when wealth does not include house equity |

Table 1.1 (Cont.)

| Authors | Dependent Variable | Data | Sample | Uncertainty Measure | Main results |
|---|---|---|---|---|---|
| Ceritoğlu, E. (2013) | savings | micro (pooled) | Turkey (2003-2009) | Individual disposable income is interacted with predicted probability of becoming unemployed | Evidence of precautionary savings |
| Chamon, M., Liu, K., and Prasad, E. (2013) | savings | micro (panel) | China (1989-2009) | Variance of income shocks | Increase in transitory uncertainty can help explain the rising saving rates |
| Dardanoni, V. (1991) | consumption | micro (cross-section) | UK (1984) | Variance of labour income levels within each group (constructed according to economic occupations) | Around 60% of saving is due to precautionary motives |
| Deidda, M. (2013) | precautionary saving | micro (cross-section) | Italy (2002) | Earnings variability through: income variance, variance of income growth and square of average annual rate of income growth | Households appear to use precautionary saving to protect themselves against financial risk |
| Dynan, K.E. (1993) | consumption growth | micro (panel) | USA (1985) | Variance of consumption growth | Small precautionary motive |
| Engen E. M., and Gruber, J. (2001) | financial wealth | micro (panel) | USA (1984-1990) | Variation in Unemployment Insurance generosity and unemployment risk as the probability of being unemployed at a point in time | Significant negative relationship between UI generosity and wealth holdings with a stronger effect for individuals facing higher unemployment risk |
| Flavin, M. (1981) | consumption | macro (time-series) | USA (1949III - 1979I) | Changes in permanent income to the test the PIH and the excess sensitivity of consumption | Strong evidence against the PIH |
| Guariglia, A. (2001) | saving | micro (panel) | UK (1991-1998) | Subjective probability of job loss, income variance, variance of income growth and square of average annual rate of income growth | There exits a significant precautionary component in saving behavior |
| Guariglia, A., and Kim, B. Y. (2003) | savings | micro (panel) | Moscow ( 1996, monthly data) | Time-varying measures of consumption growth variability | Strong evidence of precautionary saving |
| Guariglia, A., and Rossi, M. (2002) | consumption growth | micro (panel) | UK (1992-1997) | Variance of the earnings equation residuals | Strong precautionary motive for saving |

Table 1.1 (Cont.)

| Authors | Dependent Variable | Data | Sample | Uncertainty Measure | Main results |
|---|---|---|---|---|---|
| Guiso, L., Jappelli, T., and Terlizzese, D. (1992) | demand for risky assets | micro (cross-section) | Italy (1989) | Subjective variance of real income (from information of variance of expected inflation and expected income growth) | Evidence of precautionary saving, but small in magnitude |
| Guiso, L., Jappelli, T. and Terlizzese, D. (1996) | consumption | micro (cross-section) | Italy (1989) | Subjective earnings uncertainty based on household answers to two questions about the probability distribution of the rate of growth of their earnings, and the | Precautionary saving accounts for 2% of households' net worth |
| Hahm, J. H. (1999) | average net household savings and consumption growth rates | macro (panel) | OECD data for 22 countries (1960-1987) | Conditional variance of income | Precautionary saving motives are important explaining the cross-country differentials in consumption growth and saving rate |
| Hahm, J. H. and Steigerwald, D. G. (1999) | saving rate and consumption growth rate | macro (time-series) | USA (1981III-1994IV) | Conditional variance of income | Precautionary savings are an importante source of observed changes on consumption and savings |
| Hubbard, R. G., Skinner, J., and Zeldes, S. P. (1994) | asset-income ratio and saving rate | micro (cross-section and panel data sets on households) | USA (70's, 80's) | 3 sources: earnings, medical expenses & lifespan | Precautionary saving is relevant in explaining the wealth accumulation data in U.S. |
| Hubbard, R. G., Skinner, J., and Zeldes, S. P. (1995) | wealth accumulation | micro (cross-section and panel data sets on households) | USA (70's, 80's) | 3 sources: earnings, medical expenses & lifespan | Precautionary saving and social insurance programs can explain household wealth accumulation |
| Kazarosian, M. (1997) | wealth | micro (panel) | USA (1966-1981) | Variance of income | Strong precautionary savings |
| Kopecky and Koreshkova (2014) | wealth | micro (cross-section) | USA (2002, 2004, 2006) | Risk in earnings, out-of-pocket medical and nursing home expenses, and survival | There is precautionary saving, but the strengh of it varies with the type of risk considered |
| Liu, Z. (2014) | financial wealth | micro (cross-section) | China (1995, 2002) | Reform of labor security (China's SOE reform in the late 1990s) | Support the precautionary saving hypothesis |

Table 1.1 (Cont.)

| Authors | Dependent Variable | Data | Sample | Uncertainty Measure | Main results |
|---|---|---|---|---|---|
| Lusardi, A. (1997) | wealth | micro (cross-section) | Italy (1989) | Subjective variance of income | Precautionary wealth is about 3% of total wealth accumulation with OLS estimates but between 20% and 24% with instrumental variables estimates |
| Lusardi, A. (1998) | wealth | micro (cross-section) | USA (1992) | Variance of income using subjective probabilities of job loss | Precautionary saving motive is important |
| Menegatti, M. (2007) | expected consumption growth | macro (panel) | Italy (1981-2000) | Variance of GDP growth rates and conditional variance by means of the expectation of GDP growth | Confirm the importance of the precautionary saving motive on consumption decisions |
| Menegatti, M. (2010) | consumption growth and saving rate | macro (panel) | 24 OECD countries (1950-2000) | Conditional variance of output growth | Data confirm that uncertainty increases saving but the effect of uncertainty on consumption growth is less clear |
| Miles, D. (1997) | consumption | micro (cross-section) | UK (1968, 1977, 1983, 1986, 1990) | Household income variability | Precautionary motives are important explaining households savings |
| Mishra, A. K., Uematsu, H., and Fannin, J. M. (2013) | wealth | micro (pooled) | USA (2007-2009) | Variance of income | Households facing higher income uncertainty accumulate more wealth |
| Mody, A., Ohnsorge, F. and Sandri, D. (2012) | household net saving rate | macro (panel) | 27 advanced economies (1980-2010) | Unemployment rate, GPD volatility and stock market volatility | More than 40% of the increase in savings can be directly related to the increase in unemployment risk and GDP volatility |
| Pericoli, F., and Ventura, L. (2012) | consumption | micro (panel) | Italy (1989-2006) | Probability of marital splitting | Family disruption risk generates precautionary savings |
| Skinner, J. (1988) | saving | micro (cross-section) | USA (1972-73) | Income uncertainty proxied by occupation of head households | No evidence for the precautionary motive: those in riskier occupations saved less than average (self-selection) |

### 1.4.1. The choice of the dependent variable

The theoretical framework summarised in Section 1.2 provides rationale for the use of alternative dependent variables in the econometric exercises: the consumption level (or consumption growth), savings (level, growth or the saving rate), or even wealth or its accumulation. The final choice often depends on the available data and on the specific analysis carried out.

Some authors have analysed the proportion of wealth (of a country or of a household) explained by the presence of uncertainty, or how the wealth-to-income ratio varies when a source of uncertainty is included into the model (see, Caballero, 1991; Hubbard et al., 1995; Guiso et al., 1996; Kazarosian, 1997; Lusardi, 1997, 1998; and Carroll and Samwick, 1998). In these cases, the relationship between uncertainty and an increase in wealth (or in the wealth-to-income ratio) reflects the existence of precautionary saving, which is expected to be stronger the greater the increase of wealth (in absolute or relative terms). Caballero (1991) finds that precautionary savings account for as much as 60% of total stock of wealth while Kazarosian's (1997) estimates show that precautionary wealth ranges from 30% to 46% of total wealth. Carroll and Samwick (1998) find a strong precautionary saving using U.S. data and suggest that precautionary wealth is about a third of households' total wealth.

Other authors analyse the impact of uncertainty on consumption. If there is precautionary saving, uncertainty in the current period should increase savings and therefore decrease current consumption causing a positive future consumption growth and an increase in the slope of the consumption path. For example, Zeldes (1989a) or Carroll (1994) with U.S. data, Dardanoni (1991), Miles (1997) or Banks et al. (2001) for the United Kingdom, and Menegatti (2010) with OECD data, estimate consumption equations which include an uncertainty term, finding a positive precautionary motive for saving. However, also with U.S. data, Dynan (1993) finds weak evidence of precautionary saving. Benito's (2006) results for British households vary depending on the uncertainty measure used: he finds significant precautionary saving when using a predicted measure of uncertainty

(objective measure obtained through a first-step probit model) but, with a self-reported subjective measure, results fail to support the precautionary saving hypothesis.

Finally, in several studies precautionary savings are analysed by using directly saving equations. Jappelli and Pagano (1994), Hahm (1999), and Menegatti (2010) with OECD data; Hubbard et al. (1994) and Hahm and Steigerwald (1999) with U.S. data; Guariglia (2001) for British households; Guariglia and Kim (2003) for a sample of Muscovite households or Chamon et al. (2013) using China's urban household data, are examples of empirical works following this avenue. All these studies find positive evidence on the existence of precautionary savings.

A particularly important point is raised by Deidda (2013). She uses precautionary saving as the dependent variable, finding evidence of its existence in Italy. In particular, Deidda (2013) uses the log of precautionary saving scaled by the desired permanent income. This approach is possible because the 2002 survey of the Italian Survey of Household Income and Wealth (SHIW) had a direct question about precautionary wealth, precluding thus for the need to estimate it.[26] The use of the subjective measure provided by the SHIW allows taking into account additional sources of risk beyond income risk (in particular, this author investigates the impact of both financial and labour income risk on precautionary wealth accumulation). Another advantage in using a self-reported measure of precautionary wealth rather than measures of effective consumption or wealth is that it helps disentangling the effect of precautionary behaviour from the effect of other contingencies (i.e. negative past shocks or financial market imperfections) which might reduce households' effective

[26] The question is as follows: *"People save in various ways (depositing money in a bank account, buying financial assets, property, or other assets) and for different reasons. A first reason is to prepare for a planned event, such as the purchase of a house, children's education, etc. Another reason is to protect against contingencies, such as uncertainty about future earnings or unexpected outlays (due to health problems or other emergencies). About how much do you think you and your family need to have in savings to meet such unexpected events?"*

resources, giving rise to a low or null amount of wealth held for precautionary reasons (a bias towards zero wealth accumulation).

### 1.4.2. The measurement of uncertainty

In addition to the different issues addressed so far as regards the existence of precautionary saving and its analysis, the most important unresolved issue is how to measure uncertainty. Standard theoretical models of consumer behaviour show that the optimal pattern of consumption is described by an Euler equation, relating the expected growth of future consumption with the conditional variance of consumption growth rate (see Attanasio, 1999).[27] However, it has been shown (see for instance Carroll, 1992) that the latter cannot be directly estimated empirically since the conditional variance may be an endogenous variable depending on the accumulated wealth. This problem has been solved in the literature replacing this variable by different measures of the uncertainty on future income growth (see, Hahm, 1999; Menegatti, 2007, 2010; Mody et al., 2012; among others).

Before reviewing these alternative measures, we must take into account some considerations about the Euler equation. Hubbard et al. (1994) claim that the Euler equation may not be satisfied in two ways: "First, if there are binding borrowing constraints, so that households could be placed in a corner solution, consuming all their cash and desiring to borrow to increase their consumption. Second, the nonlinear Euler equation could be satisfied but the log-linear approximation to the Euler equation could generate apparent rejection", (Hubbard et al., 1994, p. 87). Also, Hahm and Steigerwald (1999) show that the sign of the coefficient of income uncertainty is unclear in the standard Euler equation (they use a model of a representative consumer who lives infinite periods, has a utility function of the CARA type, and maximizes the expected present value of lifetime utility). Moreover, Lusardi (1993), combining data from the Consumption Expenditure Survey (CES) and the Panel Study of

[27] Usually, the Euler equation includes also income growth, to capture the existence of liquidity constraints or myopia effects of the consumers who consume all of their income.

Income Dynamics (PSID) for the United States, concludes that the Euler equations are strongly rejected for all the consumption types included in the former: food consumption, "strictly nondurable consumption" (includes the lowest amount of durable goods) and non-durable consumption (includes goods which can be considered durables or semi-durables). In addition, Zeldes (1989a) claims that "the test using aggregated data generally rejects the Euler equation" (Zeldes, 1989a, p. 294).

Determining the adequate measure of income uncertainty is a complex task. There is no consensus in the literature about which measure better reflects the effect of uncertainty on consumption and saving decisions. But there is also a lack of consensus as regards the type of data that should be used, and this is the first issue we deal with: the use of macroeconomic or microeconomic data; each alternative has a number of advantages and disadvantages and, in addition, the measures of uncertainty that can be derived will differ.

Aggregate measures of income uncertainty (based on macroeconomic data) present several advantages. They are easily accessible, because, in general, there is more availability of macro data and, in addition, the time dimension is usually longer than the typically found in micro data. The use of macroeconomic data allows for comparisons between countries or areas since they have a more homogeneous construction methodology than micro data (based largely on surveys whose questions and possible answers do not necessarily coincide across countries). Furthermore, there are variables such as the unemployment rate, which are important sources of uncertainty (see, for example, Bande and Riveiro, 2013), but that can only be applied in a macroeconomic context, since they cannot be calculated at the household level.[28]

However, aggregate measures are not likely to provide a good indicator of the uncertainty faced by individuals given that consumption (and saving) decisions are taken at the micro level

[28] Among the works using macro data we highlight the contributions of Hahm (1999), Hahm and Steigerwald (1999), Lyhagen (2001), Menegatti (2007, 2010), Mody et al. (2012) or Bande and Riveiro (2013).

(individual or household).[29] Therefore, micro data should be a better option than macro data since the latter cannot be used to measure the specific risk of households, which may be far more relevant to consumers than the effects of a general economy shock (see Miles, 1997). In any case, micro-level data can also be affected by different problems related to uncertainty measurement. Microeconomic data are generally obtained from surveys which portray the uncertainty *measured* by econometricians, but it is likely that individuals have more information about their future income. Therefore, the measured uncertainty does not necessarily correspond to the true uncertainty faced by the individual. Furthermore, even if this is not the case, the uninsurable component of labour-income risk may be lower than the measured income uncertainty. For instance, households could have insurances reducing non-diversifiable risk (see Caballero 1991). On the other hand, studies at individual or household level usually cover short time periods (at least shorter than those using macro data), which prevents a good understanding of the degree of persistence of labour income shocks, a relevant issue in the setting of linkages between income uncertainty and human wealth.[30]

Both in terms of micro and macro data, several alternative measures of uncertainty have been used in empirical works. A wide branch of the literature has estimated uncertainty by the income variability; other authors have used the variability of consumption or expenditure, while others take variables related to the labour market, mainly the unemployment rate.

Traditional but "atheoretical" measures of income uncertainty are based on the standard deviation or the variance of income (see Zeldes, 1989a; Dardanoni, 1991; Blundell and Stoker, 1999; among others). At the micro level, some examples in this direction are Caballero

[29] According to Browning and Lusardi (1996), this is the reason for just considering works using micro data in their review of the empirical literature on savings.

[30] Among the group of works using micro data we highlight the contributions of Hall and Mishkin (1982), Skinner (1988), Zeldes (1989a, b), Guiso et al. (1992, 1996), Dynan (1993), Lusardi (1993, 1997, 1998), Carroll (1994), Carroll and Samwick (1997), Kazarosian (1997), Miles (1997), Banks et al. (2001), Guariglia (2001), Guariglia and Kim (2003), Benito (2006) and Deidda (2013).

(1991), who measures labour income uncertainty by the standard deviation of the percentage change in the annuity value of human wealth, or Miles (1997), who uses the variance of income and its standard deviation (based on household characteristics and estimated cross-section relationships between these characteristics and the unforecasted component of income, or its square). Both find a strong precautionary saving using U.S. and U.K. data, respectively. On the other hand, using panel data for the United States, Kazarosian (1997) proxies individual-specific income uncertainty by the standard deviation of the residual of the estimated (log)income–age profile of each individual; while Guariglia and Rossi (2002), using British data, calculate the variance of the earnings equation residuals in the following year as income volatility. Both works show evidence of precautionary saving.

A theory-based measure of income uncertainty is the Equivalent Precautionary Premium (EPP) derived by Kimball (1990) and used by Carroll (1994) and Carroll and Samwick (1998) taking US data from the Panel Study of Income Dynamics (PSID). Carroll (1994) uses two additional measures: the variance of normalized income and its standard deviation, and finds that in spite of a negative relationship between consumption and the three measures, the EPP performs best. Carroll and Samwick (1998) include in their wealth equations the log of the variance of the log-income as an atheoretical measure of uncertainty (besides the log of the relative Equivalent Precautionary Premium) finding that coefficients on both variables are highly significant for the three measures of wealth considered, namely very liquid assets, non-housing non-business wealth and total net worth.

All of the measures of income uncertainty reviewed so far are *objective measures* (calculated or predicted) but *subjective measures* can also be an alternative. Guiso et al. (1992) and Lusardi (1997), using Italian data from the 1989 Survey on Household Income and Wealth (SHIW), find scant conclusive evidence in favour of the hypothesis of precautionary saving.[31] They analyse precautionary

[31] Precautionary saving accounts for 2% of households' net worth according to Guiso et al. (1992). Lusardi (1997) finds that precautionary wealth is only about 3% of total wealth

saving by constructing a measure of subjective earnings uncertainty based on household answers to two questions about the probability distribution of the rate of growth of their earnings, and the inflation in the year following the interview.

At the macro level, income uncertainty has been proxied by measures of the variability of GDP. The most commonly used measures of uncertainty about the growth of future output are the variance of income and the conditional variance of income (or income growth rates).[32] Using data for different OECD countries, Hahm (1999) and Menegatti (2010) find a positive relationship between aggregate GDP variability and savings. Menegatti (2010) finds, however, that the uncertainty effect on consumption growth does not seem to be strongly supported by the data. In his work, Hahm (1999) assumes that the process describing the series of GDP growth is the same for each country while Menegatti (2010) tries to overcome this limitation computing a measure of uncertainty which allows heterogeneity in the stochastic processes, selecting for each country the best ARMA process describing the series. On the basis of the ARMA model, he next computes conditional variability. Menegatti (2007) studies the effects of precautionary saving in Italian regions through two different measures for income uncertainty. The first is a measure given by the variance of GDP growth rates while the second is obtained by computing the conditional variance by means of the expectation of GDP growth. The results obtained confirm the importance of the precautionary saving motive on consumption decisions. Hahm and Steigerwald (1999) also use aggregate data in their study of precautionary saving in the United States. They measure uncertainty by computing expected growth using data from a survey of U.S. income forecasts, and their results support the existence of precautionary saving.

accumulation using OLS estimates, while the percentage rises to a range between 20% and 24% when instrumental variables estimates are used.

[32] The conditional variance of income is computed on the basis of deviations of output growth from its expected value (i.e., the conditional variance of output growth and not just its variance).

A second branch of literature has proxied uncertainty by the variability of consumption expenditures. Dynan (1993) states that "consumption variability is a better measure of risk because the consumption of an optimizing household changes only in response to unexpected changes in income, which represent true risk" (Dynan, 1993, p. 1105). She approximates income uncertainty by the variance of consumption growth, finding a precautionary motive in the U.S. which is too small and inconsistent with plausible risk-aversion parameters. Dynan (1993) includes financial risk as Guariglia and Kim (2003), who, in contrast, find strong evidence of a precautionary motive in a panel of Muscovite households. In the same line, Baiardi et al. (2013) test the precautionary saving hypothesis for six advanced economies, controlling for financial risk and background risk (measured either by medical expenses or a proxy for environmental risk).[33] Their test is based on both measures and on their interaction. They find a positive and significant effect of the interaction of financial and environmental risks on consumption growth.

During economic downturns uncertainty about the future rises, and a good deal of uncertainty about future income is explained by rising unemployment. Therefore, another branch of the literature has chosen to proxy uncertainty by the probability of continuing to receive labour income in the future. This is closely related to the probability of being employed and therefore to the unemployment rate. As Deaton (2011) points out, unemployment typically has a greater negative impact on welfare than can be accounted for by reductions in income. Since most consumers get their income from labour, losing the job is the largest negative shock on income, and the risk of future episodes of unemployment should be a good indicator of uncertainty (see Malley and Moutos, 1996; Lusardi, 1998; Guariglia, 2001; Carroll *et al*., 2003; Benito, 2006, for a discussion).

In empirical works, income uncertainty due to the unemployment risk is proxied by different variables. Studies based on micro data have made use of the *ex-ante* (subjective and/or predicted) probability

[33] Canada, France, Italy, Spain, United Kingdom and the United States; over the period 1960-2007.

of becoming unemployed, which is estimated on the basis of individual characteristics (Carroll et al., 2003). The works from Lusardi (1998), Guariglia (2001), Benito (2006) or Ceritoglu (2013) follow this path. The first calculates a measure of income risk from subjective probabilities of job loss provided by the first wave (1992) of the Health and Retirement Study (HRS) for the U.S. The interviewed individuals are asked to evaluate the probability of losing their jobs during the year following the survey.[34] From that information Lusardi (1998) derives a measure of income variance (which is used in the estimation of the precautionary saving model) and finds that those perceiving a higher income risk are those saving more and accumulating more wealth. However, the contribution of precautionary saving to wealth accumulation is not very large and certainly cannot explain the wealth holdings of the very rich. Guariglia (2001) and Benito (2006) construct several uncertainty measures and test precautionary saving by using different waves of the British Household Panel Survey (BHPS). On the one side, Guariglia (2001), as Lusardi (1998), constructs a first measure as a function of the perceived subjective probability of job loss by households.[35] Moreover, she estimates three additional household specific measures of earnings uncertainty, concluding that there is a strong precautionary motive for saving whatever the uncertainty measure considered.[36] Benito (2006) follows two approaches to measure uncertainty: firstly, the subjective probability of becoming unemployed in the next twelve months, and secondly, the predicted probability of job loss (calculated from a probit model), finding different results for each measure.

[34] The question is as follows: *"Sometimes people are permanently laid off from jobs that they want to keep. On a scale from 0 to 10 where 0 equals absolutely no chance and 10 equals absolutely certain, how likely is it that you will lose your job during the next year?*"

[35] The seventh and eighth survey waves include the following question: *"In the next twelve months, how likely do you think it is that you will become unemployed?*" the responses are scaled to 0-1 and they can be interpreted as a subjective probability distribution of job loss.

[36] The first measure is obtained by taking the square of the difference between detrended household earnings in the first and the last year of her sample, divided by the number of years in the sample to have an annual rate. The second one is the variance of income, $Y_t$, over the eight available waves (this measure assumes that all income shocks are transitory). The last measure is the variance of income over waves two to eight (variance of $Y_t - Y_{t-1}$), and contrary to the previous one, this measure assumes that all income shocks are entirely permanent.

Predicted probabilities provide more variation in the levels of job insecurity in comparison with the dummy for subjective feelings of job insecurity. With the self-reported measure, Benito's results are that job insecurity does not decrease current consumption, and therefore he concludes that from this perspective there is not precautionary saving. But by using the estimated measure of risk he finds evidence of significant precautionary saving effects associated with unemployment risk and job insecurity.[37]

Ceritoglu (2013), using the predicted probability of becoming unemployed derived from a first stage probit model constructs the same measure of labour income risk as in Lusardi (1998) and Guariglia (2001) and finds evidence of precautionary saving for Turkish households.

On the other hand, for the Spanish economy, Barceló and Villanueva (2010) using data from the *Encuesta Financiera a las Familias* (EFF) (2002 and 2005 waves) analyse the hypothesis that the existence of precautionary saving implies that households perceiving greater job instability postpone their expenses (i.e., these households would show higher consumption growth rates than those households with a low probability of becoming unemployed, whose consumption patterns will be more stable over time). They approximate the probability of job loss by the type of contract of the main earner, finding that consumption growth (mainly for total nondurable consumption) is higher for households whose income earners are more exposed to risk of job loss than for those who are not.

A different approach is adopted, for example, by Banks et al. (2001), who construct terms of conditional variance of income risk but also capture changes in unemployment risk, as well as changes in uncertainty related to income or wages, considering all income sources not just earnings or wages, (they also include in the equations work status variables and unemployment rates as instruments). Their results show evidence in favour of a strong and increasing precautionary motive for saving for the British households.

[37] In addition, he also finds that consumption responds more to permanent income than to transitory income.

When macroeconomic variables are used to proxy uncertainty on the labour market status, the usual practice is to use either the observed unemployment rate (Mody et al., 2012) or subjective measures based on consumer opinion surveys on unemployment expectations (Carroll and Dunn, 1997); in both cases the conclusion is that savings increase as unemployment rises or expectations worsen. Some works following this approach are those of Mody et al. (2012), who analyse the relationship between saving rates and different sources of uncertainty (they use the aggregate unemployment rate as a proxy of income loss risk, and an alternative based on GDP volatility "to capture other aspects of income volatility not strictly linked to unemployment risk"). They find that the saving rate is positively correlated with both measures of uncertainty, i.e., both are highly significant in explaining the evolution of saving rates in 27 advanced economies. The unemployment rate and the saving rates are correlated even after controlling for disposable income growth and for the interest rate.[38] Bande and Riveiro (2013) follow a similar approach using regional data from the 17 Spanish regions. They test the precautionary motive for saving considering two types of uncertainty measures: the regional unemployment rate and the future income volatility (they calculate the expected variance of future regional output growth). Following Menegatti (2010), they compute the expectation of the output growth rate on the basis of the specific dynamics of GDP in each region, and conclude that there exists a precautionary motive for saving, especially when the level of uncertainty is variable and persistent over a period of time.

### 1.4.3. The control variables

Consumption and saving decisions, as well as wealth accumulation, are influenced by the consumer's or household's economic situation, the perceived uncertainty, but also by the household or individual characteristics and the existence of credit

[38] Their results show that "more than two fifths of the increase in savings can be directly related to the increase in unemployment risk and GDP volatility. Saving rates also significantly increased in response to financial wealth losses, which may have themselves been caused by the increase in uncertainty".

market constrains, among others. Thus, broadly speaking, precautionary saving depends on the personal characteristics of the individual taking consumption and savings decisions, and on the environment in which these decisions are made, especially, the existence of public insurances and credit constraints. The empirical works on this topic widely differ on the type of control variables included in the estimations. In this subsection we explore this dimension.

Firstly, consumption (and saving) decisions must depend on available resources (and/or the ability to borrow, i.e., the existence of liquidity constraints). Therefore, income should be an important determinant of consumption. Thus, current income is often included within the set of covariates (see, for example, Caballero, 1991; Miles, 1997; Hahm and Steigerlwald, 1999; Guariglia, 2001; Menegatti, 2010). Lagged income has also been used as an explanatory variable (see Menegatti, 2007; or Bande and Riveiro, 2013; among others). Moreover, income can be decomposed into its transitory and permanent components (see Kazarosian, 1997; Lusardi, 1997; Guariglia, 2001; Benito, 2006; Deidda, 2013; or Liu, 2014; for example). The different income sources have also been controlled for, either those stemming from the labour market or those from other sources, such as investments (Miles, 1997, or Benito, 2006, include income from investments in their estimations).[39]

Likewise, equations can include past consumption to capture habit formation (see, for example, Guariglia and Rossi, 2002) or different types of wealth (real, human or financial). Thus, previous year wealth is often included in the consumption equations (Caballero, 1991; Hubbard et al., 1994; for example), while Zeldes (1989a) or Carroll (1994), among others, include current human and financial wealth.[40]

[39] Under this approach, permanent income shocks can be used as proxies for uncertainty.
[40] Wealth can be used to classify households into rich or poor and some measures of this variable can be a proxy to credit constraints (for example, Zeldes, 1989b, classifies as liquidity constrained those households with low savings or financial assets levels).

In most regressions, family dummies are included to capture the family-specific effects. Some of them, depending on their availability, are family size or composition (see, for example Skinner, 1988; Lusardi, 1993, 1997; or Banks et al., 2001), existence/number of children, dependent children[41] (as in Miles, 1997; Kazarosian, 1997; Lusardi, 1997; Carroll and Samwick, 1998; or Guariglia and Kim, 2003) and the number of income recipients[42] (Dynan, 1993; Lusardi, 1998; or Guariglia and Kim, 2003; among others). Other variables reflecting personal characteristics commonly used are age (it allows analysing consumption/income profiles by age), gender, race, marital status, health or education (see, for example, Guiso et al., 1996; Kazarosian, 1997; Carroll and Samwick, 1998; Lusardi, 1998; Guariglia, 2001; Benito, 2006; or Deidda, 2013).

As regards education, an increase in the education level may imply a lower temporal preference rate and therefore foster more savings (see Kazarosian, 1997). Dynan, 1993; Lusardi, 1993; Guariglia, 2001; Chou et al., 2006; Kureishi and Wakabayashi, 2013; or Mishra et al., 2013; who include education as a control variable and, in general, results show that more educated households save more).

Health status is included by some authors due to the assumption that individuals with poorer health have a higher probability of unforeseen medical expenses and, therefore, they will save more. Given the different types of public health systems coverage, this variable will be more relevant in some countries than in others. In this line are the results from Deidda (2013) or Guiso et al. (1996) for Italy, proxying health by the number of days the person was ill during the year previous to the survey, or the results of Lusardi (1998) using US data and measuring wealth through a set of dummies of self-reported health status. Guariglia (2001) and Benito (2006) also use a self-reported measure from UK households (both from the BHPS) and,

[41] On the one hand, children can be a source of security in retirement, thereby decreasing saving (Kazarosian, 1997); on the other hand, consumption should be increasing with the number of children, and saving capacity would decrease (Miles, 1997).

[42] Guiso et al. (1996) include the number of pension recipients, pointing out that they have less income risk.

while the former finds that health status does not have a statistically significant effect on savings, the latter shows that poor health status increases the probability of job insecurity (more uncertainty). In contrast, Kazarosian (1997) using health dummies (self-reported status of health) from US data, finds that, contrary to predictions, an individual in worse health saves less than one in better health.

Also environmental conditions are included as control variables in the analysis of consumption/saving behaviour. The approach is that the dynamic of pollution affects consumption growth and hence savings. Baiardi et al. (2013, 2016) include the level of pollution (growth rate of CO2 emissions) as a proxy of the level of environmental quality in their estimated equations capturing this way the direct effect of pollution on consumption growth and find a positive sign for this coefficient. Their results imply a positive relation between environmental degradation and consumption growth in some OECD and Mediterranean countries, respectively.

Since unemployment episodes are one of the main factors behind income variations, there are many job-related variables that can be used to analyse which individuals are more likely to have precautionary savings. At the macro level, the variance of (regional) unemployment can be included in the set of independent variables or as instrument (for example, Lusardi, 1997, uses the regional unemployment rate as an instrument for subjective earnings variance), but at the micro level, assigning a reference unemployment rate to individuals may not be possible. Therefore, other variables that could be considered are union membership, hours worked, years of experience, employer size, job insecurity or whether the individual was unemployed in the previous year. In general, the first four variables have a negative relation with uncertainty (see Lusardi, 1997; Miles, 1997; or Benito, 2006; among others) while for the latter two the relation is positive.

The individual's type of occupation is another of the covariates most commonly found in the literature. Leland (1968) and Sandmo (1970) point out that we should expect that self-employed, farmers or sales workers "save more, as their incomes are more variable" (Leland

1968, p. 471). Deidda (2013) finds similar results for Italian households and Mishra et al. (2013) obtain that U.S. self-employed farm households accumulate more wealth. Using U.S. data, Skinner (1988) investigated the hypothesis that the average saving rate should be higher for those in riskier occupations (he approximates uncertainty through different occupation proxies). Contrary to expectations, Skinner finds that saving rates are lower for occupations with presumably higher income uncertainty (such as self-employed and sales workers). Carroll (1994), Kazarosian (1997) and Lusardi (1997) also find results in this line. The impact of occupation might be ambiguous due to a possible self-selection bias (i.e., workers with lower risk aversion choose professions or jobs with higher income risk). The amount of savings by occupation levels depends on the different workers' risk aversion, and therefore this control variable may be a bad proxy for income risk. Carroll (1994) offers another possible explanation for lower savings of workers with riskier incomes. He asserts that "people with high income save more, regardless of the effect of uncertainty" (Carroll, 1994, p. 141), and thus if workers with riskier incomes are also workers with lower income, they will save less, regardless of uncertainty or self-selection.[43]

Since the uncertainty perceived by individuals is affected by their own characteristics and/or the characteristics of the environment in which they make decisions, (as for instance the existence of a welfare system), precautionary saving may also be affected by the latter. Therefore, in recent years there is a growing literature following a rather different methodological approach: some control variables are used to cluster individuals into different groups (according to certain common characteristics) and then the effect of uncertainty on consumption/saving decisions among the different groups is analysed. Some examples are presented below.

[43] Given the self-selection problem, Dynan (1993) notes that "while it is plausible that people will choose their occupations or industries partly on the basis of their attitudes toward risk, it seems less likely that risk plays a noticeable role on people's decisions concerning education, number of earners in a household, or holdings of liquid assets" (p. 1112). So, a way to tackle the problem of self-selection is to focus on the sets of instruments for which self-selection is less likely to occur.

Potential changes in the family structure constitute an important source of risk: the financial position changes when people marry, divorce or have children, as wealth increases or divides, and the spending needs and the expected future income of household change (see Love, 2010). Being so, some works analyse differences in the precautionary behaviour of individuals according with their marital status or gender. Pericoli and Ventura (2012), using data from the Italian Survey on Households Income and Wealth, show that an increase in the objective probability of family dissolution has a negative impact on non-durable consumption and a positive impact on household precautionary saving (they estimate that precautionary saving accounts for 11% of total household savings). Kureishi and Wakabayashi (2013) analyse wealth for a sample of Japanese single women, taking two groups: those who do not expect to get married within the next three years, and those expecting to be married in the same period. Their results show that single women who are not likely to get married within three years have higher wealth target for preparing for illness, disaster, and emergency as well as for retirement, that is, expectations of remaining single in the future cause women's precautionary savings. They also conclude that the higher a single woman's annual income, the higher her wealth target for precautionary purposes.

In relation with differences by the age of the individual, Chamon et al. (2013) conclude that Chinese households with younger heads respond more strongly to a shock to the transitory variance of income, and their argument is that households with the youngest household heads need to save more in order to build a buffer stock of savings. Kopecky and Koreshkova (2014) highlight the difference in the uncertainty sources for young and elderly: during the working period individuals face earnings uncertainty but retired individuals face uncertainty with respect to their survival as well as medical and nursing home expenses (Kopecky and Koreshkova, 2014, p. 2). Their results show that precautionary saving account for 12% of aggregate savings in U.S., and they conclude that saving is made in order to self-insurance against old-age health expenses given the absence of complete public health care for the elderly.

As mentioned earlier, uncertainty about the future and its effect on consumption/saving decisions are greatly affected by the existence of insurances covering unforeseen events, specially health and unemployment insurance. In fact, there is a growing concern about the design, the implementation and the required changes in health and unemployment insurance systems to guarantee their sustainability. In this regard, there are a large number of studies relating the consumption/ saving decisions with the existence of this kind of insurances for countries with very different systems. Liu (2014) points out that the policy reforms in China have increased job uncertainty, fostering precautionary saving, due to the gradual abolition of guaranteed lifetime employment and benefits. Ceritoglu (2013) studies household saving decisions in Turkey and shows that health insurance coverage is an important factor affecting workers' participation in the workforce (and hence on precautionary saving), since most individuals get health insurance and social security coverage through their employment contracts (Ceritoglu, 2013, p. 117). Gruber (1997), using annual observations on food consumption expenditures from the PSID, finds strong evidence that unemployment insurance smooths the individual consumption of American households. The results from Engen and Gruber (2001) are in the same line. Using U.S. micro data, they find that a reduction in the unemployment benefit increases gross financial asset holdings and that this effect is stronger for individuals facing higher unemployment risk and weaker for older workers. Since the young have low savings and high incentives to find a job, Michelacci and Ruffo (2015) claim that the unemployment benefits should be more generous for the young; this result is consistent with that of Engen and Gruber (2001): the effect of a change in the unemployment insurance is stronger for young workers. On the other hand, estimations of Chou et al. (2006) show that the introduction of National Health Insurance in Taiwan decreased households' savings by 1% to 10%, depending on the econometric technique used. Also, using Taiwanese data, Kuan and Chen (2013) find that the National Health Insurance (NHI) has a negative effect on household's savings. They also show that the NHI has greater impact on the households with higher income and those with retiring head, mainly on high

savers in these groups (high savers tend to have a greater reduction in savings after the national insurance is enforced).

As explained earlier, precautionary savings exist because under an uncertainty context individuals behave prudently and they decrease the consumption rate, increasing the rate of saving. Being so, the higher the financial literacy of individuals, the better the individual's perception on the existence and consequences of uncertainty would be and, therefore, the greater the effect of uncertainty on savings. In fact, in the last years there is another growing branch of the literature analysing the relationship between individual or household saving decisions and their level of financial literacy. Bernheim et al. (2001), in a study for the US, find that financial education at high school increases the rate at which individuals save and accumulate wealth during their adult lives. Van Rooig et al. (2012) also find evidence of a positive relationship between financial literacy and wealth accumulation in the Netherlands, being the reason, according to the authors, that "financial literacy knowledgeable individuals are more likely to invest in stocks and have a higher propensity to plan for retirement" (p. 471). In this regard, several works analyse the relationship between financial literacy and retirement planning or retirement saving adequacy (see, Lusardi and Mitchell, 2011, for the US; Alessie et al., 2011, for the Netherlands or Bucher-Koenen and Lusardi, 2011, for the case of Germany). However, greater financial education does not always guarantee better financial decisions and higher savings rates. In fact, the results of the effects of previous financial literacy efforts and household saving decisions are mixed (see Gale et al., 2012, for a review of several studies).

A final set of explanatory variables commonly included in precautionary savings estimations are related to the credit market and household's financial status. Guariglia (2001), for example, takes into account whether households expect their financial situation to deteriorate or to improve, if it is worse or better than expected, and if it is simply good or bad. Additional variables can be whether the household received help from parents or friends, the financial development at regional level, whether the households owns a credit card or the number of years of relationship with a bank. Some of these

variables are included by Guiso et al. (1992) or Deidda (2013), for example. The former show that one explanation for Italy's high savings rate is the relatively low level of development of financial markets while the latter finds that Italian households receiving help from relatives significantly reduce their need to save for precautionary motives.

Finally, we should point out that the existence of credit constraints has generated a considerable discussion in the literature in terms of their likely effect on precautionary saving.[44] It is unclear how the existence of liquidity constraints influences consumption and saving decisions. The PIH assumes that individuals can borrow at the same interest rate they receive for their savings. But usually the interest paid on credit card debt, car lettering, and other types of loans is much higher than the interest on financial assets in which saving can be allocated. In addition, some individuals have reached the limit of its borrowing capacity and cannot keep borrowing whatever the interest rate is. Therefore, in those studies in which the PIH is rejected empirically, liquidity/borrowing constraints are often suggested as a possible explanation.[45] Borrowing constraints may influence consumption and saving decisions but it remains unclear how these relate to precautionary saving: whether they are substitutes, i.e., the existence of credit constraints imply the non-existence of precautionary saving, if borrowing constraints reinforces income risk effects or even if they are not related.

Some authors avoid including liquidity constraints in their analysis of precautionary savings (see, for example, Zeldes, 1989a). Others include them and find that they may induce precautionary

[44] We should note that according to some authors (see, for example, Jappelli and Pagano, 1994) borrowing constraints may foster a higher rate of economic growth by inducing capital accumulation, since aggregate saving will be higher than in the presence of perfect credit markets.

[45] Under certainty, the life-cycle model predicts that borrowing constraints should bind only during youth. In a context of uncertainty on earnings, out-of-pocket medical expenses, and lifespan, this will no longer be the case. However, Guiso et al. (1992) and Hubbard et al. (1995) point out that the younger are likely to be liquidity constrained (especially until their mid-thirties) and, in addition, under a consumption floor, borrowing constraints can bind at any time in the life cycle (Hubbard et al., 1994).

saving even when utility is quadratic, i.e. the imposition of liquidity constraints turns the consumption function concave (see, for example, Carroll and Kimball, 2001);[46] or that they can increase aggregate savings with cross-section variation of income even in the absence of uncertainty (Feigenbaum, 2011). On the other hand, the presence of income risk affects the relationship between borrowing constraints and the composition of the household portfolio. Households expecting to be liquidity constrained hold less risky assets. The general conclusion is that liquidity constraints may increase savings in two ways. On the one hand, when the liquidity constraint becomes a spending limit, the individual will consume less than he would do otherwise. This happens because if an individual would like to transfer additional resources from "tomorrow" to "today" but he is limited in doing so, the marginal utility of consumption "today" respect to "tomorrow" should be greater than the one predicted in a model without constraints (Zeldes, 1989b). On the other hand, even when such restrictions do not impose spending limits, the threat of future restrictions discourages present consumption. Liquidity constraints encourage individuals to save in order to insure them against the effects of future income falls. In this sense, liquidity constraints interact with and reinforce the precautionary saving motive (Deaton, 1991; Deidda, 2013; Blundell et al., 2014), i.e. the effect of borrowing constraints reinforces that of income risk (Guiso et al., 1992).

### 1.4.4. The determination of an empirical estimate of the coefficient of relative risk aversion

The determination of an empirical estimate of the coefficient of relative risk aversion is an important issue in the empirical literature on precautionary saving since Dynan's (1993) work. In the empirical precautionary saving analysis, under the assumption that utility is CRRA, an empirical estimate of the coefficient of relative risk aversion can be obtained. Applying a second-order Taylor

[46] The effects of credit constraints and precautionary saving are very similar since both stem from the concavity of the consumption function (Carroll and Kimball, 2001).

approximation of $U'(C_{t+1})$ to the Euler equation (1.3) and rearranging yields:

$$E_t\left(\frac{C_{t+1}-C_t}{C_t}\right) = EIS\left(\frac{r-\delta}{1+r}\right) + \frac{\rho}{2}E_t\left[\left(\frac{C_{t+1}-C_t}{C_t}\right)^2\right] \qquad (1.13)$$

Where $EIS \equiv -U'/(U''C_t)$ is the elasticity of intertemporal substitution, the inverse of the coefficient of relative risk aversion and $\rho = -(U'''/U'')C_t$ is the coefficient of relative prudence defined by Kimball (2001). The second uncentered moment of the distribution of expected consumption growth, $E_t[((C_{t+1}-C_t)/C_t)^2]$, is a measure of the expected consumption risk. Equation (13) indicates that an increase in the expected consumption risk is associated with higher expected consumption growth.

The size of the coefficient of relative prudence ($\rho$) determines the strength of the precautionary saving motive. Under the CRRA utility function the parameter $\gamma$ represents the coefficient of relative risk aversion ($\gamma = -(U''/U')C_t$) and the coefficient of relative prudence is equal to the coefficient or relative risk aversion plus one ($\rho = \gamma + 1$). Common choices for $\gamma$ range from 1 to 4 (see Dynan, 1993); thus the expected size of $\rho$ is between two and five.[47] Dynan (1993) was the first attempt to identify the coefficient of relative prudence using panel data from the Consumer Expenditure Survey. Since the survey does not provide information on expectations about consumption, Dynan replaces these with their realized counterparts, that is, with the average consumption growth for the analysed period plus an error term:

$$avg(CG) = EIS\left(\frac{r-\delta}{1+r}\right) + \frac{\rho}{2}avg(CG^2) + \epsilon \qquad (1.14)$$

The error term, $\epsilon$, is a composite error term reflecting not only error terms associated with replacing expected values with their

[47] The condition (4) holds for the constant relative risk aversion (CRRA) utility function and the constant absolute risk aversion (CARA) function but does not hold for quadratic utility. In this last case, expected consumption risk does not affect expected consumption growth, and the consumption profile depends only on the elasticity of intertemporal substitution, the interest rate and the rate of time preference.

sample means but also "taste shifters". Since this error term is correlated with $avg(CG^2)$, i.e. realized consumption risk, Dynan uses Two-Stages Least Squares to obtain consistent estimates of ρ. Although she finds that risk affects consumption growth positively, she cannot reject the hypothesis that the coefficient of relative prudence is zero, implying a negative coefficient of relative risk aversion.[48]

Also in an Euler equation framework, Bertola et al. (2005) use the subjective variance of income one year ahead (provided by the Italian Survey of Household Income and Wealth) as an instrument for the expected consumption risk. They find that subjective income risk is a powerful instrument and obtain a significant coefficient of relative prudence around two, thus providing evidence in support of the precautionary saving model. On the other hand, Christelis et al. (2015) using survey data from the CentER Internet panel, which is representative of the Dutch population, estimate directly equation (4) using subjective expectations of future consumption rather than relying on realized consumption magnitudes. Thus, the error term is not correlated with expected consumption risk and the equation can be estimated even with a cross-section or with a short panel. They estimate the Euler equation using different estimation methods (OLS, robust regression and IV) and obtain strong evidence for a precautionary motive for saving and an estimated coefficient of relative prudence around two.

On the other hand, Baiardi et al. (2013) show that the problem found by Dynan (1993) on the estimation of the coefficient of relative prudence can be due to the omission of relevant uncertainty sources such as environmental risk. They use time series data for Canada, France, Italy, Spain, UK and US and provide new estimates of the size of relative prudence and relative risk aversion taking into account the presence of two simultaneous risks: the environmental risk together

[48] The instruments explain only a small part of the variability of consumption implying that the coefficient of relative prudence is imprecisely estimated (Christelis et al. 2015).

with the financial risk.[49] They obtain an estimated coefficient of relative risk aversion between 1.5 and 3, and hence a relative prudence coefficient between 2.5 and 4. Their results also suggest that interaction between the two risks is relevant in determining precautionary saving and consumption growth. More recently, Baiardi et al. (2016) provide new empirical evidence on the coefficients of relative risk aversion and relative prudence in some Mediterranean countries.[50] They also include both financial and environmental risks and their results confirm the conclusions obtained by Baiardi et al. (2013). Excluding the implausible estimates obtained for some of the analysed countries, the coefficients of relative risk aversion are between 0.78 and 3.03 (implying a coefficient of relative prudence ranging between 1.78 and 4.03 depending on the country). On average the Euro-Asian Mediterranean countries are the most risk averse.

## 1.5. CONCLUSIONS

This chapter presents a comprehensive review of the literature on precautionary saving where saving is defined as the difference between disposable income and consumption expenses, and therefore the determinants of consumption also determine savings. In the context of the standard LC/PIH model, savings smooths the consumption pattern, which should be financed with an irregular (but certain) income flow. In this case, there is no risk and there is no need to be prudent, but only to assign optimally. Once we introduce uncertainty about future income, since individuals tend to behave prudently, precautionary saving arises. The models show that if the assumption that the utility function is quadratic is removed (and it is assumed instead that the marginal utility is convex, $u'''(\cdot) > 0$), uncertainty affects consumption and savings decisions and generates

[49] Environmental risk is described by the variance of consumption growth, computed using, for each year, observations of the previous five years. Environmental risk is described by the variance of pollution growth (proxied by CO2 emissions).

[50] It is the first paper studying macroeconomic impacts of environmental risk including developing countries. In particular, they use data from 13 Mediterranean countries (Albania, Algeria, Croatia, Cyprus, Egypt, Greece, Israel, Lebanon, Malta, Morocco, Slovenia, Tunisia and Turkey) during the period 1965–2008.

an extra positive saving, the precautionary saving. In other words, an increase in uncertainty about future income will reduce current consumption and will alter the slope of the consumption pattern.

The consideration of precautionary saving allows to give a satisfactory explanation to some inconsistencies reached in the empirical tests of the standard theory of consumption, which have been dubbed as the consumption puzzles.

The size of the coefficient of relative prudence determines the strength of the precautionary saving motive and has been an important issue in the empirical literature. Under the CRRA utility function the parameter $\gamma$ represents the coefficient of relative risk aversion and the coefficient of relative prudence ($\rho$) is equal to $\gamma + 1$. Common choices for $\gamma$ range from 1 to 4 (see Dynan, 1993); thus the expected size of $\rho$ is between two and five.

Since saving is defined as a residual, most of the empirical works on precautionary savings take as the dependent variable either accumulated wealth or consumption, and in general they use micro data because they best capture consumption and saving decisions, which are decisions taken at the individual level. In addition to income and wealth, a number of control variables are included in the explanation of savings. Not only socio-demographic variables (like gender, age, marital status, children, education or financial literacy) are commonly used to control for characteristics of individuals (or to group them to analyse the different uncertainty effect on savings decisions) but also the risk coverage of unemployment or health trough public insurances are considered. The main problem that arises when analysing the uncertainty effects on consumption and saving decisions is how to measure uncertainty and in fact the empirical literature has not reached a consensus about taking subjective or objective measures nor about the particular uncertainty proxy. Not only it is necessary to find a measure which is consistent at a theoretical level, but the difficulties involved with missing data or its adequacy must also be added.

In sum, although most of the reviewed works find evidence of precautionary motive for saving there is not a consensus on the

magnitude of this effect, and some works conclude that this motive is nearly irrelevant. Therefore, there is still much to be done and the potential contributions that can be made in this field are numerous.

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# 2. PRECAUTIONARY SAVING IN SPAIN: EVIDENCE USING CROSS-SECTION UNCERTAINTY MEASURES[51]

## 2.1. INTRODUCTION

In this chapter we test the precautionary savings hypothesis for a sample of Spanish households, using a panel of subjective and objective uncertainty measures. These are constructed from the Survey of Household Finances (Encuesta Financiera de las Familias, EFF), provided by the Bank of Spain. Therefore, the chapter also provides a complete description of the EFF and its methodology.

As it gathers the first chapter, the literature on consumption and savings has reached a consensus as regards to the theoretical conditions under which uncertainty generates additional household savings, the so-called precautionary savings (see inter alia Leland 1968; Sandmo 1970; and Drèze and Modigliani 1972). However, the empirical tests of the precautionary saving hypothesis have found mixed results. Depending on the type of data, country, or econometric approach, different authors provide inconclusive evidence.

By using uncertainty measures based on the standard deviation or the variance of income, Caballero (1991) and Kazarosian (1997) find a strong precautionary saving in U.S. while Miles (1997) or Guariglia and Rossi (2002) show evidence of precautionary saving in U.K. In the same vein, Carroll (1994) and Carroll and Samwick (1998), with U.S. data and using the Equivalent Precautionary Premium and some measures also based on the standard deviation and the variance of income to proxy uncertainty, find that coefficients on all variables are

[51] Based on this chapter a paper entitled "Precautionary saving in Spain during the great recession: evidence from a panel of uncertainty indicators" has been published on the Review of Economics of the Household. DOI 10.1007/s11150-018-9412-6

highly significant. However, Guiso et al. (1992) and Lusardi (1997) find scant conclusive evidence in favour of the hypothesis of precautionary saving when they analyse precautionary saving constructing a measure of subjective earnings uncertainty using Italian data. On the other hand, Mastrogiacomo and Alessie (2014) show that the small estimated precautionary effect for Dutch households may be a result of a methodological shortcoming, and find that taking into account the uncertainty as perceived by the second income earner in the household precautionary saving accounts for about 30% of total saving.

The literature using uncertainty measures based on labour market performance also shows very different results. Guariglia (2001), using British data and measuring uncertainty through subjective probabilities of job loss, concludes that there is a strong precautionary motive for saving. Ceritoglu (2013), finds also evidence of precautionary saving for Turkish households using the predicted probability of becoming unemployed. However, Lusardi (1998), using uncertainty measures based on ex-ante subjective probability of becoming unemployed, finds that although those perceiving a higher income risk are those saving more and accumulating more wealth, the contribution of precautionary saving to wealth accumulation is not very large and certainly cannot explain the wealth holdings of the very rich in the U.S. Also by using as uncertainty measure the subjective probability of becoming unemployed, Benito (2006) shows that job insecurity does not decrease current consumption in U.K. However, when he uses the predicted probability of job loss (calculated from a probit model) results support the hypothesis of precautionary saving effects associated with unemployment risk and job.

This chapter contributes to the existing literature in three main aspects. Firstly, using a sample of Spanish households we find new evidence in favour of the existence of a precautionary savings motive. The econometric results unambiguously confirm the existence of a negative impact of uncertainty on consumption. Secondly, we show that depending on the specific uncertainty measure its impact on consumption is different. In general, we find that subjective measures (based on self-perception about future household income variability)

tend to generate a non-significant impact on consumption, and hence on savings. Objective measures (as the risk of losing the job, proxied by the unemployment rate, or the job insecurity that the household reference person faces) generate a significant negative impact on consumption. Finally, we show that the impact of these objective measures is different depending on the moment of the business cycle we are studying. Specifically, we find that in a context of low jobless rates, the uncertainty measured through the unemployment rate exerts no impact on household consumption, whereas when it is high and rising it becomes an important source of income uncertainty, generating a large share of precautionary saving. However, when we control for time-invariant effects by estimating a fixed-effects panel data model, contrary to expectations, the unemployment rate has a significant and positive effect on consumption which casts doubts on the validity of this variable as an adequate uncertainty measure. The job insecurity measure, on the contrary, is significant at all business cycle horizons as well as in the panel specification.

The main feature of this analysis is the inclusion of multiple measures of uncertainty. In the existing literature each author has constructed different measures based on the specific information provided by their dataset. This chapter reviews these measures and includes as many as possible given our data in the specification of an empirical consumption function. This allows us to check which of these measures are more reliable as uncertainty sources for the households included in our sample. Moreover, we construct an individual composite index of job insecurity, based on the information provided by our dataset, which allows us to introduce a novel source of income uncertainty, the job insecurity faced by the household reference person. This individual composite index combines information on seniority, type of contract, type of job arrangement (part time/full time), number of previous employers, firm size and unemployment record. The higher the index the more vulnerable the worker is to a potential job loss, and thus we expect a fall in current consumption to increase saving as a buffer against future contingencies. To the best of our knowledge, this is the first time that

a composite index of this type is introduced in a consumption equation to test the precautionary saving hypothesis.

Another feature of this analysis is that it collects data for two years (2008 and 2011), allowing thus comparisons between household consumption behaviour before and during the Great Recession. The magnitude of such recession, especially in the Spanish case, is likely to have modified the underlying consumption and saving patterns. Our results suggest that indeed this is the case, and that different uncertainty sources impact on household decisions on different moments of time.

After this introduction, the chapter is organized as follows. Section 2.2 briefly summarises the theoretical framework underlying the econometric analysis. Section 2.3 provides a description of the data and its characteristics. Section 2.4 comprises the explanation of the uncertainty measures constructed. Section 2.5 presents the econometric model and the results and finally, Section 2.6 concludes.

## 2.2. THEORETICAL FRAMEWORK

The rationale for our econometric analysis below lies in the standard theoretical framework of consumption/savings decisions in a context of uncertainty (see Leland 1968; Sandmo 1970; and Drèze and Modigliani 1972) in which individuals tend to behave prudently (Kimball 1990).

Standard theoretical models of consumer behaviour show that the optimal pattern of consumption is described by an Euler equation, which relates the expected growth of future consumption with the conditional variance of the consumption growth rate (see Attanasio 1999).[52] However, the latter cannot be directly estimated empirically, as indicated by Carroll (1992), since the conditional variance may be an endogenous variable depending on the accumulated wealth. This problem has been solved in the literature replacing this variable by different measures of uncertainty.

[52] Usually, the Euler equation includes also the income growth to capture the existence of liquidity constraints or myopia effects of the consumers which consume all their income.

A wide branch of the literature has proxied uncertainty through the variability of income (see *inter alia* Zeldes 1989a; Caballero 1990; Guiso *et al*. 1992; Carroll 1994; Kazarosian 1997; Lusardi 1997; Miles 1997; Blundell and Stoker 1999; Hahm 1999; Guariglia and Rossi 2002; Menegatti 2007, 2010; or Kitamura *et al*. 2012) using the standard deviation or the variance of income (see for example Zeldes 1989a; Blundell and Stoker 1999; or Kitamura *et al*. 2012). In this same line are also the works of Caballero (1991), who measures the uncertainty of labour income by the standard deviation of the percentage change in the annual value of human wealth, or Miles (1997), who uses the variance of income and its standard deviation as a measure of uncertainty. Both find evidence of a strong precautionary saving in the US and UK, respectively. Using panel data from the US, Kazarosian (1997) proxies the individual specific income uncertainty by the standard deviation of the residual of the profile (log) income-age estimate of each individual. Guariglia and Rossi (2002) estimate the variance of the residuals of an earnings equation in the following year as the volatility of income, using British data. Both studies show evidence of the existence of precautionary savings. Also Carroll (1994) and Carroll and Samwick (1998) with the Panel Study of Income Dynamics (PSID) data obtain evidence of precautionary savings in the United States using several measures of income variability.

A different branch of literature has proxied uncertainty by the variability of consumption/expenditures. Dynan (1993) states that "consumption variability is a better measure of risk because the consumption of an optimizing household changes only in response to unexpected changes in income, which represent true risk" (p. 1105).

During recessions uncertainty about future income increases, which is to a great extent explained by rising unemployment. Thus, another branch of the literature has proxied uncertainty by the probability of continuing to receive labour income in the future. Since most consumers get their income from labour, losing their job is the biggest negative impact on their income, and the risk of future episodes of unemployment would be a good indicator of the uncertainty (see Malley and Moutos 1996; Lusardi 1998; Guariglia

2001; Carroll *et al*. 2003; Benito 2006; Barceló and Villanueva 2010; Cuadro-Sáez 2011; Sastre and Fernández-Sánchez 2011; for a discussion). This is closely related to the probability of being employed, and therefore to the unemployment rate.

Despite the large number of papers analysing the existence of precautionary saving, the empirical results are not conclusive. There is no consensus about the strength of this precautionary motive neither has the existing literature reached a definite answer to what is the most appropriate measure of uncertainty. Consequently, we will include in our empirical analysis several measures of uncertainty about future income as well as a number of control variables commonly used in the literature (such as income, wealth, debt, credit constraints, risk aversion and individual and familiar characteristics of households and its members). In particular, and using the Spanish Survey of Household Finances (see below) and external data (taken from the Labour Force Survey), we construct several measures related to the probability of continuing to receive labour income in the future and the household income variability.

### 2.3. SURVEY OF HOUSEHOLD FINANCES (EFF): DATA DESCRIPTION AND METHODOLOGY

Although aggregate measures of income uncertainty (based on macro data) present several advantages, the use of microeconomic information is a preferable option since the former cannot be used to measure the specific income risk of households and the information portrayed in the latter may be far more relevant to analyse consumer behaviour, especially in the context of the precautionary savings hypothesis (see Miles 1997).[53] Therefore, the use of a microeconomic

[53] Among papers using macro data we highlight the contributions of, among others, Hahm (1999), Hahm and Steigerwald (1999), Lyhagen (2001), Menegatti (2007, 2010), Mody et al. (2012) or Bande and Riveiro (2013). In the group of papers using micro data good examples are the contributions of Hall and Mishkin (1982), Skinner (1988), Attanasio and Weber (1989), Zeldes (1989a, b), Guiso et al. (1992, 1996), Dynan (1993), Lusardi (1993, 1997, 1998), Carroll (1994), Carroll and Samwick (1997), Kazarosian (1997), Miles (1997), Banks et al. (2001), Guariglia (2001), Guariglia and Kim (2003), Benito (2006), Deidda (2013) and Mastrogiacomo and Alessie (2014).

dataset is preferred to analyse several aspects of the economic and financial situation of households and to assess the difference between consumption patterns before and during the current crisis. Thus, in this thesis we use the data from the Survey of Household Finances (*Encuesta Financiera de las Familias*, EFF hereafter) which allow analyse the household consumption behaviour measuring the uncertainty trough different variables.

It is an official survey compiled by the Bank of Spain which has been done since 2002 (each three years) in order to obtain direct information about the financial conditions of the Spanish families. The survey provides information about different aspects of the economic and financial situation of Spanish households before and during the current crisis and, therefore, allows to analysing the consumption/saving patterns of Spanish households.

It is the only statistical source in Spain that allows the linking of incomes, assets, debts and expenditure of each household. The survey of Banca d'Italia, Survey on Household Income and Wealth (SHIW), and the Survey of Consumer Finances (SCF) of the US Federal Reserve were the models that inspired this survey. It was developed for the years 2002, 2005, 2008, 2011 and 2014 and consists on the following sections:

1. Demographic characteristics (all households)
2. Real assets (all households)
3. Debts (all households)
4. Businesses and financial assets (all households)
5. Insurance policies and pension schemes (all households)
6. Employment situation and related income (all household members over 16)
7. Non-employment income / Income from real or financial assets received by the household in the preceding calendar year
8. Use of means of payment and new distribution channels (all households)

9. Consumption and saving (all households)[54]

Questions regarding assets and debts refer to the whole household, while those on employment status and related income are specified for each household member over 16 years. Most of the information relates to the time of the interview, although all income (before taxes) information is also collected relating to calendar year preceding the survey. The collection of this information is carried out with personal interviews to the households. In general, the interviews took place between the last months of the current year and the second quarter of following year. These interviews were conducted with the help of computer, due to the complexity of the questionnaire.[55]

All the EFF waves have two objectives, the first is to achieve a sample representative of the current population with an oversampling of wealthy households and the second is to convert part of this sample in a panel by re-interviewing households who participated in previous waves. So the main characteristics of this Survey are that includes an over-sampling of rich households and a panel component.

*Panel component*

Since the second wave some households which had collaborated in previous editions have been interviewed again. So the combination of the waves allows observing a subset of households in different points in time. A household is considered a household panel if at least one of its members in the current wave was a member of one of the participating households in the previous wave. The Bank of Spain conducted a thorough inspection of the panel state of households, its members, and the correspondence between waves. The panel

[54] In contrast with the SCF, the questionnaire contains some questions about spending on nondurable goods and food, given the interest of the relationship between consumption, income and the different types of wealth.

[55] The questionnaire used in all waves was presented as a "Computer Assisted Personal Interview" (CAPI) which facilitates the task of interviewers in this complex questionnaire, allows some basic checks for errors in the interview stage, and allows automatic conversion of pesetas to euros and vice versa. Fieldwork for surveys of wealth and income is particularly demanding because it is given a high lack of response due to the nature and difficulty of the questions. In the 2011 wave all errors were assigned to one of 16 categories which were subsequently rated according to seriousness of the error in order to help to solve these errors in the following waves.

component provides statistical information on transitions between states and individual changes in magnitudes also it facilitates the study of causal effects.

To ensure the representativeness of the study the sample, selected randomly, includes observations of all economic strata and has the support of the National Institute of Statistics for its elaboration. That is, in each new wave a refreshment sample by wealth stratum is included to supplement the panel component up to a total sample size of 7,000 households and to ensure that, when used jointly with the panel, the overall sample would fulfil representativeness and oversampling requirements. As a preliminary step for the design of the refreshment component, the wealth (and income) tax information of the panel sample was updated. In the second and third waves the aim was to have a full panel component i.e. the aimed to re-interview all households that participated in the previous wave (EFF2002 and EFF2005, respectively) but, in the fourth wave (EFF2011) they did not aim to re-interview all households that participated in the EFF2008, they were decided to keep in the panel sample only all households participating since 2002 because they form a subsample of households in which almost ten years of their life-span can be observed.[56,57] In relation with this longitudinal dimension, in the EFF2014 a rotation system has been introduced limiting the maximum number of waves in which a household may participate in the survey. In particular, in the EFF2014 sample, households that were interviewed in the EFF2002 are not included. So, in this last way, a system of linked sub-panels has been introduced, making it possible to combine the representativeness of economic activity at each time with the longitudinal component.[58]

[56] 300 households participating since 2005 (out of 2,042) and 600 participating since 2008 (out of 2,230) were randomly dropped for the 2011 sample.

[57] In contrast with the previous two waves, in the 2011 wave no replacements were provided for panel households. This allowed for a larger refreshment sample.

[58] The total number of valid interviews obtained in the EFF2014 was 6,120, of which 3,060 correspond to households that already collaborated in the EFF2011. Of these 3,060 households, 905 have participated since 2005, 619 since 2008 and 1,536 since 2011.

*Oversampling of wealthy households*

The other key feature of the EFF is, following the example of the SCF, the oversampling of households with a higher level of wealth. The Bank of Spain considered this of great importance when designing the survey because the distribution of wealth is highly skewed; usually a small fraction of the population has a large part of household wealth and also some asset classes are only held by a small fraction of the population. Thus, a standard random sample would not contain enough observations for many analysis of wealth microdata. Therefore, it was considered very important to have a sample that was not only representative of the whole population, but also of aggregate economic wealth, and to facilitate the study of financial behaviour in the upper part of the distribution wealth. The achievement of a significant oversampling of wealthy households in this survey is made possible through the collaboration of the National Institute of Statistics (INE) and the Tax Agency.

The existence in Spain of a wealth tax has allowed that the EFF oversampling of households with a higher level of wealth was based on individual declarations of wealth. The definition of the wealth stratum was based on the intervals of the SCF and on the percentile distribution of households filing a wealth tax return. [59] Eight strata were defined in each wave with increasing oversampling with the level of wealth strata.[60] In Navarre and the Basque Country there was no oversampling of the wealthy because the national Tax Office does not hold the personal tax file information for these regions.

The oversampling rate is defined as the ratio between the number of observations that there are actually in the sample for a range of

[59] In the SCF a wealth index integrating information on capital income statements included in the individual income tax is built, since in the United States, there is no wealth tax.

[60] The intervals used for EFF2011 were the same as for EFF2008 and these, in turn, were revised upward from the values used for EFF2002 and EFF2005. But in the EFF2014 only seven strata were considered and oversampled progressively at higher rates. The reason for that is the new wealth tax regulation approved in Spain in 2011 which increases the non-taxable minimum wealth amount to 700,000€ so that just 130,216 individuals filed a wealth tax return. So, wealth strata were re-defined based on the new percentile distribution of the taxable wealth of those households filling a wealth tax return.

specific percentiles of the distribution and the number of observations one would expect if the sample was mined at random from the population. The degree of oversampling in the final sample is satisfactory in all the waves. In the 2002 wave, the segment of households own 40% of the aggregate taxable capital is represented in the sample of the EFF by about 500 observations. In the absence of oversampling, would be expected to have, in the best case, if the response rate was uniform strata, with only 20 households in this stratum. In the EFF2005 or in the EFF2008, for the wealthier 1% the number of observations is around nine times what would be expected with random sampling. The highest percentile of the wealth distribution is represented in the sample of the EFF2011 by 693 households and in the 2014 wave by 707 households , more than eleven times what would be expected by random sampling (would be expected to have only 61 households in this percentile in both waves). If we had to rely only on observations resulting from random sampling, statistical analysis of that segment of the population in which the more complex financial decisions are focused would be very difficult.

To try to preserve the oversampling to the extent possible, a very careful replacement procedure was designed.[61] In large cities and provincial capitals up to four replacements were provided for each original household in the sample that would serve as replacements of that household only. These replacements were the two households immediately before and the two immediately after the household in a list ranked by income quartile (for non-filers of wealth tax), wealth stratum, and per capita household income. Replacements had to belong to the same income quartile (for non-filers of wealth tax returns) or the same wealth stratum as the sample household. This was done within municipalities, in the case of large cities, and within census sections in the case of small towns, to keep replacements geographically not too distant from the original sample household.

[61] An important reason in the case of the EFF for having controlled replacements was the fact that the Bank of Spain does not have any indication of the wealth stratum to which the sample households belong, thus ruling out the possibility of a "directed" effort during the field work should it be found that the response rate of certain strata was particularly low.

This meant that sometimes become available four substitutions less (and in some circumstances, no). In the case of Navarra and the Basque Country a more standard system of a pool of eight replacement households as potential substitutes for eight sample households within the same primary sampling unit (PSU or census section) was adopted.

### 2.3.1. Sample design, cooperation rate and control and validation

The population frame for the sample in all waves was the Municipal Register in which the units are households as defined by their address. With this information sent by the INE to the Tax Office, the latter constructed for each address three variables based on information drawn from both wealth and income tax returns. These variables are the wealth stratum indicator, a variable indicating the quartile in the national taxable income distribution which the household belongs to and the per capita income of the household and were the starting point for the sampling.[62] The sampling design differed depending on municipality size. For all provincial capitals (there are 52 of them) and municipalities over 100,000 inhabitants, fresh oversampling was designed to supplement the panel sample by wealth stratum taking into account the updated wealth strata of panel households. Within each of the wealth strata the new sampling was random. For municipalities with 100,000 or fewer inhabitants there was no fresh oversampling. The sampling was a two stage cluster design in which the PSUs were the same as those used in the first and second waves. The PSUs were selected with a probability proportional to their population. Within each PSU, households were randomly selected to supplement the panel households belonging to it, up to an overall number of seven households per PSU. Oversampling in municipalities was achieved only for PSUs with ten or more wealth

[62] The income variables were helpful in the selection of sample replacements (as we shall see below), and to ensure that households from all income levels were selected in the sample. The latter was obtained by using systematic sampling with random start in a properly ordered data frame. Furthermore, the income quartile indicator was used to correct for nonresponse in large cities.

tax filers. For these PSUs four wealth tax filers and four non-wealth tax filers had been drawn. Sampling for Navarre and the Basque Country was similar to that for the group of smaller municipalities but with a finer stratification by municipality size for small municipalities. Specifically, the panel sample was supplemented up to a total of seven households within each of the PSUs used in the previous waves.

The cooperation rate, defined as the ratio between the number of completed interviews and the sum of the number of completed interviews and refusals to participate, was 47.3% in the first two waves, increased to 61.0% in the third, dropped to 50.8% in 2011 and increased to 58.9% in 2014. In all waves cooperation rate decreases when wealth stratum increases, a result in line with those obtained in similar samples in other countries. In addition, in the last four waves, the total cooperation rate hides large differences between panel component and non-panel in all strata, being much lower in the non-panel component.

The last phase carried out in relation to the collection of data through surveys, was the control and validation of the same by the Bank of Spain who reviewed all completed interviews to uncover potential inconsistencies and improbable values. This process control and validation was carried out since the beginning of fieldwork to identify possible misunderstandings and bad practices by some interviewers, in order to correct them. This was made possible through random and targeted phone calls to households with a strict predefined script of questions to check the work of interviewers. During this review process the fieldwork enterprise contacted again with the households where to obtain additional information or clarify some already obtained was considered important.[63]

The EFF team at the Bank of Spain also examined the completed interviews for overall individual consistency. As a result of this process it was decided to discard: (i) completed interviews where no income information was provided (neither labour income nor asset income nor assistance income of any kind), except in the case of panel

[63] The most common errors found in the responses recorded were, first, euro vs. pesetas and, secondly, misinterpretation of certain questions by some interviewers.

households with a high percentage of answered euro questions, and (ii) interviews where less than 30% of the euro questions were answered, unless that percentage increased substantially when answers provided in range form were taken into account. These conditions emerged as natural cut-off points after having reviewed the informational content of the completed interviews and are the same for all waves.

### 2.3.2. Weights

To obtain representative magnitudes of the population, elevation factors are calculated, i.e., the frequency with which the sample households are in the total population of households. To calculate these factors are considered, mainly, the characteristics of the sample design, but various adjustments are made, in particular to collect the different nonresponse rate by levels of income and wealth.[64] The elevation factor of sampling design for each household are obtained naturally from their unique population frame as the inverse of the probability of being included in the sample. In a first step, these initial elevation factors have been adjusted by non-response within cells defined by different sample design variables (which differ depending on the size of the municipality). In particular, these include: municipality size, wealth stratum, and income quartile for non-filers of wealth tax returns in large cities, the proportion of wealth tax returns in each PSU and PSU size. It was not possible to make an additional adjustment for regions within those cells, by insufficient sample size. In line with the confidentiality restrictions, design and non-response weights were calculated by the Tax Office following detailed instructions from the National Statistics Institute.

Based on previous elevation factors, the INE conducted an analysis of sample estimates of several population characteristics: age, education, employment status, sex and household size. Estimates obtained by education and employment situation are satisfactory, but it was noted that the sample was biased towards smaller households

[64] Bover (2004) explains in the document "Description and methods of the 2002 survey" the preparation process of elevation factors and adjustments made to them.

and older individuals. Therefore, the first expansion factors were adjusted (by a linear distance function using the Calmar procedure) to adapt to the age structures, household size and sex of the Population Register (Padrón). To improve the weights, the different age structures provided by the Census by size of municipality, distinguishing between large municipalities (more than 100,000) and the rest, were considered for this adjustment. It is expected that the response rates between age groups vary by size of municipality. Especially considering that oversampling by wealth was conducted primarily in large municipalities and response rates between age groups are probably different depending on the wealth stratum.[65]

In the following waves, due to the existence of a panel component, cross-sectional and longitudinal weights are provided. As in the EFF2002, design and non-response weights were calculated by the Tax Office following detailed instructions from the National Statistics Institute.[66] The weights construction in the last four waves of the EFF is described like follows:

*Longitudinal weights.*

In the EFF2005 the initial weights for the panel households were their 2002 design weights corrected for 2002 non-response. These were further corrected for the non-response in 2005 of the 2002 sample, using as reference the 2002 population. Non-response corrections in both EFF waves are made in the cells defined by the various sampling frame variables. In particular these include municipality size, wealth stratum, and income quartile for non-filers of wealth tax returns. In a second step, the aforementioned weights were adjusted to conform to the 2005 population, by wealth stratum and income quartile. Finally, these were further adjusted (by a linear distance function using the Calmar procedure) to conform to the 2005

[65] Details of the Calmar procedure, developed by the French INSEE, can be found in Sautory (1993). One useful feature of this procedure is that it allows for different levels of adjustment simultaneously, in particular, households and individuals.

[66] In the EFF2014, the weights have been calculated on the basis of the 2011 Census and present some differences in relation to their previous version based on the 2001 Census and the Population Register (Padrón), which may lead to certain variations in some magnitudes or results with respect to the already published in the documents of EFF2008 and EFF2011.

Census structure of the population according to gender, age by municipality size, and household size by municipality size.[67]

In each wave the start point to calculate the weights is the previous EFF wave. Thus, the procedure for calculate the weights in the 2008, 2011 and 2014 waves is the same that in 2005, but with reference to 2005, 2008 and 2011, respectively, instead 2002.

*Cross-sectional weights.*

To obtain cross-sectional weights, the panel and non-panel components of the sample are considered as two independent samples. The basic weights for non-panel households are the inverse of the probability of being included in the sample (as given by the sampling design), subsequently adjusted for non-response within the cells defined by the various sampling frame variables. For panel households, the basic weights are the longitudinal weights prior to their Calmar adjustment, as described earlier.

Finally, the two sample components are combined and their weights corrected according to the relative size of the sub-samples, this being the minimum variance estimator for two independent samples representing the same population. The resulting weights were adjusted using the Calmar procedure to conform to the most recent structure of the population according to gender, age by municipality size, and household size by municipality size.

### 2.3.3. Non-answer and imputation of missing data

The absence of response to isolated questions is an inherent characteristic of wealth surveys. Item non-response occurs when a household agrees to participate in the survey but fails to respond to one or more questions. The item non-response will partly depend on the stringency of the conditions (in terms of the number of key questions that have to be completed) that have to be met for an interview to be declared valid, which in turn affects unit non-response rates. This is an issue that often arises in the early stages since it may

[67] In each wave (2005, 2008, 2011 and 2014), another set of longitudinal weights that are adjusted to conform to the previous wave population will also be provided.

affect the terms of the contract with the field agency. In particular, there is a trade-off because stringent conditions would give the right incentive to interviewers but would produce self-selection into the sample in addition to that created by overall refusals to participate. Moreover, interviewers faced with overly stringent conditions are more likely to cheat or to induce answers from the household.

Answers to the questions on whether the household holds a particular asset are usually readily provided. In contrast, households may have more difficulty providing information about the value of the asset held or about the amount of a particular income source. Therefore, in the EFF2005 they introduced the possibility that for most questions in euro the household could give answers in the form of a range when not able or not willing to provide point values. Namely, when the household answered DK (don't know) to the point value question, he/she was prompted to provide an answer as a self-reported range (as defined by an upper and a lower bound) or, if failing to do so, to choose from a set of predefined ranges. Since the EFF2008 this range facility is available for answers to all euro questions. Information provided in the form of ranges (and more particularly as predefined ranges) appears to reduce significantly the proportion of DK/NA answers, mainly the DK ones, without reducing the number of point value responses.[68]

Despite the increase in the proportion of questions answered, not all the questionnaires are fully completed. Any analysis based exclusively on cases with fully completed questionnaires could lead to significant bias in the results and, therefore, the Bank of Spain has made imputations of non-observed values to facilitate the data analysis. Imputation is the process of assigning a value to an observation that was not picked up (or not collected properly). Those

[68] This was demonstrated by comparing the not answer rates to some key questions in similar tables for EFF2002, the EFF2005 and EFF2008 (see Bover, 2004, 2008, 2011). In the EFF2011 a decrease in the proportion of responses DN/NA is observed for some questions that typically showed a high nonresponse. And this decrease is reflected primarily in increases in the responses of specific values for these questions and, to a lesser extent, in responses of own or fixed intervals. The percentage of questions answered in 2014 is similar to 2011 (which was substantially larger than in 2008, 2005 and 2002).

imputations are based on advanced statistical techniques, obtaining several estimates for each not observed value, to take into account the uncertainty associated with the imputation. The statistical object of study are obtained by combining the information from these multiple imputations.

According to the model of Rubin (1996), the right thing would be that missing data are the responsibility of "*manufacturers data*" because

> "*In general, end users have neither the knowledge nor the tools to address the problems of lack of data satisfactorily. [...] The builders of databases usually know more about the reasons for the lack of response and have better access to confidential and detailed information is not available for public use [...] End users should focus on scientific analysis and for this, the missing data are usually just a nuisance*" (Rubin, 1996; page 474).

Therefore, by using auxiliary information, "*data producers*" are in a much better position to impute values that users in general.

Until recently, the most widespread ways of dealing with missing data were replace them by the mean of the observed data, "*fill-in with means*", delete the observations having lost values in at least one variable in the empirical model of interest, "*listwise deletion*", or replace missing values by other predicted values using non-stochastic imputation methods that best fit the observed data. However, these methods are not suitable because they do not preserve the complete data distribution and tend to produce concentrated distributions of variables and underestimation of variances. One of the main motivations for the EFF was to determine the distribution of real and financial assets of households, their indebtedness and their relationships with other variables. Therefore, since the objective of the imputation is not to replace the missing data by these predicted values that best fit the variables of interest, but to preserve the characteristics of distribution and relationships among different variables, only the imputation methods based on a stochastic imputation can help to preserve the complete data distribution. This is since the imputed

values are the result of adding a random number to the value predicted by the imputation model using a distribution also specified by the imputation model.

One single stochastic imputation does not take into account the uncertainty about the imputation model due to the fact that it treats the imputed value as if it was an actual one; therefore, as Rubin (1987) proposes, drawing several imputed values to assess the uncertainty about the imputation is needed. This is the reason why the EFF provides multiple imputations instead of one single stochastic imputation of the missing data.

The technique chosen in the EFF is a "stochastic multiple imputation", so that a distribution of possible values is estimated. This technique allows the uncertainty to be reflected in the imputation. The stochastic imputation for a given lost value can be defined as a random selection of the distribution of the imputed variable, subject to a set of relevant observed variables. The multiple imputation repeats the imputation process a number $m$ of times, as a way to express the latent variability in the conditional distribution, i.e., for each missing value several imputed values ($m$) are provided instead of one. In particular, the EFF imputes five values for each lost item of each household observation so these five values may vary depending on the degree of uncertainty about the imputation model.

The higher the value of $m$, the lower the loss of efficiency due to imputation; Rubin (1976) shows how the loss of efficiency varies depending on both the number of multiply imputed values, $m$, and the fraction of missing data. The reason why the number of multiple imputations in the final data sample is 5 (as in other studies, such as SCF) is that Rubin (1976) says that for the most common values of the fraction of missing data (usually less than 30%) increases in the number of imputations over 5 provide a very low efficiency gain not worth the effort in terms of time, storage and computational requirements.

The imputation of the EFF data is done assuming *missing at random* (MAR) as explained by Rubin (1976) and Little and Rubin (1987), which requires that the unanswered values behave like a

random sample of all values, but within groups defined by observed data. This assumption implies that the conditional distribution of the household responses only depends on the observed data, but not on the missing data. The goodness of this assumption will depend on the availability of observed variables that could plausibly explain the lack of response and allow perform the analysis conditioned on them.

As Rubin (1976) and Cameron and Trivedi (2005) explained, another assumption made by the imputation methods like that of the SCF and the EFF is that the *missing data mechanism is ignorable*. This occurs when the household response is missing at random (MAR) and the parameters of the missingness mechanism are distinct from the parameters of our imputation model of the missing data (i.e., are independent). If so, we do not need to specify the non-response model for imputing missing data.

For the imputation process the Bank of Spain used the multiple imputation program written by Arthur Kennickell, of the Federal Reserve of the United States, for the SCF (see Kennickell, 1991, 1998). This program is especially suited to the case of both surveys (SCF and EFF) by the characteristics they possess and which can't be incorporated into other available software packages. In particular, in data sets as complex as these, almost every observation has a different pattern in terms of the lack of response to variables, so is not possible use monotone patterns, where the variables are sorted according to their lack of response. Another important feature available in the imputation programs of SCF is the possibility of imposing restrictions on the values that should be imputed specific to each observation. This program of multiple imputation (Federal Reserve Imputation Technique Zeta or Fritz, its acronym in English) has a sequential and iterative structure. In a given iteration, the variables are allocated sequentially, and an imputed variable is taken as "observed" for subsequent imputations in the sequence and in the following iterations (but subject to update), until convergence occurs in the process.

Each iteration has two stages, in the first, called "imputation step", the missing data are imputed using estimates from the previous iteration of the parameters obtained from the distribution of missing

data conditional on the observed data. The second is called "later stage" and estimates the parameters of the complete data distribution, using the imputations of the first stage as if the imputed values were actually known or observed. Both steps occur until convergence process.

Since the imputed values of one variable are used to impute the remaining variables in the first iteration of imputation process, and these imputed data are treated as if they were actually observed to impute the remaining variables in the iteration, the order of imputation of variables in the sequence is really important. Therefore, we must impute at first place the variables having a low percentage of missing information and variables considered very good predictors of the remaining variables to be imputed. This iterative and sequential imputation is related to the development of simulation algorithms of Markov chain [Markov Chain Monte Carlo (MCMC)], particularly Gibbs sampling.[69] Once a variable is imputed, the missing values of all covariances derived from the imputed variable and participating in the imputation models of the remaining variables must be updated.

Fritz program allows three types of imputation: continuous, binary and multinomial. For continuous variables, imputation is made by adding a random factor to predictions by regression. An important feature of the program is that allows specify all the variables that we would want to use as regressors. However, in the first iteration, instead of using only the coefficients of a regression based only on complete cases, for each variable and observation that has to be imputed, the program determines the variables with response between the full set of regressors and uses the corresponding subset of rows and columns of the covariance matrix necessary for this "individual" regression. In subsequent iterations, there is a full covariance matrix using imputed data from the previous iteration.

[69] Gibbs sampling or a Gibbs sampler is an algorithm for obtaining a sequence of observations which are approximated from a specified multivariate probability distribution (i.e. from the joint probability distribution of two or more random variables), when direct sampling is difficult.

To impute binary variables, a variant of linear probability model is used to take advantage of the "individual" regression based on the covariances that just described. The multinomial variables are imputed using the "hot deck" process. This latter, imputes the most probable value of the variable to be imputed in the cell formed by the household observations having identical covariance values. The reason for not consider discrete choice models by maximum likelihood or nonparametric models to impute both types of variables, binary and multinomial, is the large number of different patterns of item missing values among observations in a survey as long as the EFF.

In order to assess whether the imputed values are reasonable or whether they can be considered atypical, each imputed value is compared with both maximum and minimum values of the imputed variable on a sample of respondents who are neighbours. Therefore, it is considered that the imputed value is reasonable if it is within the range of these maximum and minimum values that the variable of interest takes among its neighbours. This evaluation is performed just after finishing the imputation of a continuous variable in the first iteration to ensure reasonable starting values.

### 2.3.4. Logical trees and shadow values of the EFF data

In order to know the origin of the data from the EFF for a particular observation and a particular variable, each variable in the questionnaire has the corresponding "flag". In other words, all survey variables are properly marked by *shadow values* indicating the nature of the data and the reason of this lack of information (or missing value). These indicators, the "flags", provide information about whether the values have been answered by households (i.e. are really observed values) or if they are imputed. So that potential users of the survey could make imputations of data themselves using these shadow values. The "flags" also indicate whether missing values existing in the variables after imputation are really true missing values (i.e., given the household responses to the above interviewers questions, the households did not have to answer that question in particular) or

whether they have been imputed as "truly lost" during the imputation process.

The Bank of Spain creates the "flags" variables for all variables in the original data set before starting the imputation process because these shadow values are continuously used to impute the missing data.[70] This is done in two stages: first, make the response codes "don't know" and "no answer" (DN and NA) in missing values and assign the corresponding shadow values to all the survey variables. In the second stage, the Bank of Spain specifies and program all logical and potential relationships among the variables of the questionnaire, so that the shadow values can be assigned correctly in all observations and in all variables. Consequently, the logical relationships between variables are grouped into logical EFF trees variables; therefore, it is necessary to identify the total number of existing logical trees in the survey. In each tree, a variable is called "head-variable" and the remaining "branch-variables". The imputation step is based largely on all these logical trees that are established among the survey variables. The order in which the variables are imputed, jointly with the way in which the imputed value of a head variable determines the subsequent imputed value to its branch variables, is based on all logical trees involving these variables. Therefore the household response (or lack of response) to a head variable affects the branch variables, not only the actual values of the same but also their shadow values, since some observed values for a head variable may involve true missing values and restrict the values of some branch variables belonging to its logical tree. Consequently, it is necessary to program all possible logical trees to assign the correct value to shadow variables according to the values of the primary head variable in all household observations and all survey variables.

### 2.3.5. Sample for the analysis

An important aspect to consider is the labour status of the household reference person. In this survey the reference person is the

[70] Only those variables having a shadow value equal to or greater than 2050 are imputed.

person responsible for the accommodation. Since the household reference person is self-reported, it is assumed (as in Rossi and Sansone, 2017) that he or she is who chiefly takes financial decisions. The characteristics of income sources and/or the household consumption and savings patterns, as well as possible sources of uncertainty about their future earnings are likely to differ depending on the labour situation of the household reference person. We follow the general practice in the literature (see *inter alia* Lusardi 1998; Carroll *et al*. 2003; or Benito 2006) and focus on households whose reference person is an employee. Therefore, our sample is composed by all the households whose reference person is employee (regardless of age or other characteristics).[71] This decision is justified by the type of uncertainty measures we will construct (mainly related to the labour market status) and for which information is only available for this group. To avoid the effect of outliers without dropping observations (since our sample size is not too large) we have replaced the highest 1% and lowest 1% values by the contiguous values counting inwards from the extremes. In our final sample we eliminate the households with missing values in some of the uncertainty measures. In particular, we drop 30 households in the 2008 wave and 51 in the 2011 wave due to missing values for the job insecurity indicator and the measures related to the perception of the individual about losing his/her job in the future.

### 2.4. UNCERTAINTY MEASURES

We first use subjective data to build an uncertainty measure related to income variability.[72] Guiso *et al*. (1992) and Lusardi (1997) find inconclusive evidence on the precautionary saving hypothesis using subjective data of the variance of income drawn from the information provided by the Italian Survey on Income and Wealth (SHIW). Their uncertainty measure is based on household responses

[71] Table A1, in the Appendix A, contains the list of variables used in the model and their description while Table A2 provides a descriptive table of the main characteristics of households in the sample.

[72] Due to the size of our sample, obtaining estimates of permanent income is not entirely correct, ruling out this approach to the subject matter.

to two questions regarding the probability distribution of the rate of growth of income and inflation in the year following the interview. The EFF has a similar question: households are inquired about their expectations about future income.[73] However, households are only asked about if they believe that their future income will be higher, lower or equal than current income, but not the distribution of this income expectation. Therefore, from this information we can only generate a dummy variable ($Negative\ Y\ expectations$), taking value one when the household thinks that its future income will be lower than current income (bad expectations about their future household income) and zero otherwise.[74] This, obviously, limits the strength of this variable as a proxy for uncertainty.

The remaining uncertainty measures are related to the probability of continuing to receive labour income in the future. Although in this case the EFF data would allow us to construct different (objective and subjective) measures at the individual level since we have the information needed for all household members aged 16 and over, we decide to proxy the household uncertainty by that of its reference person.[75]

In empirical works, income uncertainty due to the risk of unemployment is proxied by several variables. Studies based on micro data have measured the risk of unemployment by the *ex-ante* (subjective and/or predicted) probability to become unemployed (job loss). This is the focus of the works of Lusardi (1998), Guariglia (2001) and Benito (2006), among others.

As regards the subjective measures, changes in the survey design between 2008 and 2011 do not allow us to construct exactly the same variables, although they basically measure the same concept and are comparable. In the case of the EFF2008, respondents declared whether they believed they would lose their job or not in the following

[73] The specific question is: "*Do you think that in the future your income will be higher, lower or the same as at present?*"
[74] See Appendix A for definitions of uncertainty measures.
[75] Following Guiso et al. (1992) and Lusardi (1997, 1998) we justify this procedure by the underlying assumption that the variance of household income can be reasonably approximated by the variance of the income of the household reference person.

twelve months. Accordingly, we construct a dummy ($Losing\ job$) for the reference person, taking value 1 when the individual believes that he will become unemployed in the next 12 months, and 0 otherwise.

In the EFF2011, however, respondents are asked to assign a specific probability to the event of losing their job in the forthcoming twelve months.[76] From this information we derive two uncertainty measures, using only the responses given by the household reference person. The first one (denoted $p^2\ of\ losing\ job$) is just the square of this subjective probability, which gives greater weight to higher odds of becoming unemployed. Specifically, we re-scale the probability to a 0-1 interval and square it. The second uncertainty measure is the one used in Lusardi (1998) and Guariglia (2001). Under certain simplifying assumptions, they derive a measure of the variance of income from the subjective probability of being unemployed in future. Let $p$ the subjective probability of job loss and $(1-p)$ the probability of maintaining the employment status. If the replacement rate of the unemployment insurance is zero and earnings do not change when the respondent does not lose his job (income next year will be the same as in the current year), then the individual earnings can be interpreted as a random variable, where the expected value of earnings is $(1-p)Y$ and the variance of income is equal to $p(1-p)Y^2$, where $Y$ is the logarithm of labour income (see Lusardi 1998, p. 451). Ceritoğlu (2013) also uses this measure of labour income risk, obtaining evidence of precautionary savings for Turkish households. But unlike Lusardi (1998), Guariglia (2001) or this work, he does not use a subjective probability of becoming unemployed, but rather a probability predicted from a first stage probit model. In any case, we have built this second variable of uncertainty (denoted $Variance\ of\ expected\ labour\ Y$) from the labour income data for the household reference person in 2011 (in logs) and the probability

[76] In particular, the question is: "*At present there are people who lose their job due to termination of work contract, dismissal or other reasons. On a scale of 0 to 100, what do you think is the probability that you will lose your job in the next twelve months?*"

that he/she assigns to become unemployed in the next twelve months.[77]

In addition to the subjective probability of losing the job, we can proxy the uncertainty in the labour market from several objective measures. In the empirical works at a macroeconomic level is common to use the unemployment rate as a proxy for uncertainty. Thus, those who have been assigned higher unemployment rates will be subject to greater future job insecurity than those who belong to a group with lower average unemployment rate (See Mody *et al.* 2012; Bande and Riveiro 2013; or Estrada *et al.* 2014).

Given that the EFF does not report unemployment rates (under any type of aggregation) nor the geographical location within the Spanish territory of households in the sample (such that we could assign the jobless rate of where they lived) we are forced to use external data in assigning unemployment rates to households.[78] Following Campos *et al*. (2004), we use the unemployment rates provided in the Labour Force Survey (LFS) for the gender and age group to which the household reference person belongs to. So, using the LFS microdata we compute, for each EFF wave, average unemployment rates by five-year age groups and gender, and assign those rates to the households included in the EFF. In this way, the uncertainty measure is the unemployment rate assigned to the household reference person for the current year ($Un\,rate$).[79] If the precautionary saving hypothesis holds, households would consume less the higher the unemployment rate; that is, when the reference person belongs to a group with higher average unemployment rate, the household would perceive more uncertainty about future labour

[77] The variable labour income is constructed from the income data for the reference person in the current year provided by the survey.

[78] The Bank of Spain has collected information about the province of birth and region of residence but this is not reported for confidentiality issues.

[79] Note, however, that to avoid multicollinearity this forces us to drop from the group of control variables the age of the reference person. Also, note the unemployment rate is clustered in a fixed number of groups, which must be taken into account in the estimations to avoid the Moulton or group bias, which can lead to lower standard errors. We therefore use cluster standard errors using a robust covariance matrix.

income and would reduce their consumption expenditures, i.e., precautionary saving would take place.

Labour market uncertainty can also be measured through other objective variables related to the reference person's job. Some of them are seniority, size of the company, number of employers, having a temporary contract, having been unemployed in the previous year or working part time. Overall, the first two are negatively related to the risk of job loss while the remaining have a positive relationship with uncertainty (see Lusardi 1997; Benito 2006 or Miles 1997; among others). Working part time can be a choice of the worker, but the evidence suggests that those who have this type of contract are generally subject to less job security than those who work full time. Employees who are hired on full-time or with permanent contracts may experience less job insecurity because they may have a greater feeling of being an integral part of the organization than part-time or temporary employees would (Barling and Gallagher 1996; Sverke et al. 2000). For the Spanish economy, Barceló and Villanueva (2010) using data from the EFF (waves of 2002 and 2005), find evidence in favour to the existence of precautionary savings proxying the probability of losing employment by the type of contract that the main recipients of income at household have.

Given the different dimensions of job insecurity, we opted to construct an overall composite indicator of job insecurity, rather than using these variables in isolation of one another in the econometric estimations. In particular, the six variables that make up the indicator are *seniority, working time, type of contract, number of employers, firm size and unemployment record.*

We build this uncertainty measure ($Job\ insecurity\ indicator$) by assigning a numerical value (consecutive numbers) to each of the different categories of these six variables, such that the greater the value the poorer the employment status of the household reference person (i.e. values in ascending order from best to worst employment situation). To avoid penalizing the different work situations in the variables having more categories (by construction they would have greater values of the indicator), we normalize the assigned values by

the number of categories of the variable, so that the maximum value that can be assigned is 1 in each variable. The aggregation method to construct the indicator is a linear aggregation (i.e., the sum of the normalized individual indicators) and, in this case, unweighted. The resulting job insecurity indicator is therefore the sum of the assigned values to these six variables according to the employment status of the reference person in the household. In this context, greater job insecurity is proxied by higher values of the indicator, reflecting, therefore, a greater likelihood of becoming unemployed. It is important to remind that this measure is computed at the individual level and, to the best of our knowledge, it is the first time in the literature that such type of uncertainty indicator is employed in the analysis of precautionary savings.

Table 2.1. Composition of job insecurity indicator of household reference person

| VARIABLE | CATEGORIES | ASSIGNED VALUE | STANDARDIZED ASSIGNED VALUE |
|---|---|---|---|
| Seniority | Seniority>=5 years | 1 | 1/3 |
| | 1 year<Seniority<5 years | 2 | 2/3 |
| | Seniority<1 year | 3 | 3/3 |
| Working time | Full time | 1 | 1/2 |
| | Partial time | 2 | 2/2 |
| Type of contract | Indefinite contract | 1 | 1/3 |
| | Temporary contract | 2 | 2/3 |
| | Other labour agreement/without contract | 3 | 3/3 |
| Number of employers | 1 employer or less | 1 | 1/4 |
| | Between 2 and 5 employers | 2 | 2/4 |
| | Between 6 and 10 employers | 3 | 3/4 |
| | More than 10 employers | 4 | 4/4 |
| Firm size | 500 workers or more | 1 | 1/5 |
| | Between 100 and 499 workers | 2 | 2/5 |
| | Between 20 and 99 workers | 3 | 3/5 |
| | Between 10 and 19 workers | 4 | 4/5 |
| | Less than 10 workers | 5 | 5/5 |
| Unemployment record | Not unemployed last year | 1 | 1/2 |
| | Unemployed last year | 2 | 2/2 |
| JOB INSECURITY INDICATOR = SUM OF STANDARDIZED ASSIGNED VALUES OF ALL THE CATEGORIES | | | |

Notes: Own elaboration using data from the EFF.

## 2.5. ECONOMETRIC MODEL AND RESULTS

In the existing literature three variants have been used to test for the existence of a precautionary motive for saving. Some authors analyse the effect of uncertainty on consumption (see *inter alia* Attanasio and Weber 1989; Zeldes 1989a; Coejo *et al*. 1990; Guiso *et al*. 1992; Argimón *et al*. 1993; Dynan 1993; Carroll 1994; Miles 1997; Blundell and Stoker 1999; Banks *et al*. 2001; or Benito 2006, among others). Other authors explore the impact of uncertainty estimating saving equations directly (see *inter alia* Japelli and Pagano 1994; Hubbard *et al*. 1994; Hahm 1999; Hahm and Steigerwald 1999; Guariglia 2001 or Guariglia and Kim 2003, for example). A third group of authors have analysed the proportion of wealth (of a country or a household) explained by the presence of uncertainty or how the wealth-to-income ratio varies when a source of uncertainty is included (see, for example, Caballero 1991; Hubbard *et al*. 1995; Guiso *et al*. 1996; Kazarosian 1997; Lusardi 1997, 1998; Carroll and Samwick 1998).

Among these three general approaches, the first one seems to best fit our dataset.[80] Thus, we will assess the existence of precautionary saving by analysing the effect of different types of uncertainty measures on consumption. If there is a precautionary motive for saving, uncertainty in the current period should increase savings and thus decrease current consumption, i.e., we expect a negative sign on the uncertainty variable.

The econometric model relates current consumption of a household with a number of covariates measuring personal, family, work and financial characteristics. Specifically, assuming that the underlying relationship between the dependent and independent variables can be expressed in a log-linear form, the model is:

$$logC_i = \beta_0 + \beta_1 UNC_i + \gamma X_i + \theta Z_i + v_i \qquad (2.1)$$

[80] The EFF also allows for the computation of total wealth, net worth and net financial worth, and therefore we could also opt for the estimation of a wealth equation, adding an uncertainty term. However, this analysis would be out of the scope of this chapter, and is left for future research.

Where $c_i$ is non-durable consumption of the i-th household; $\beta_0$ is the intercept; $\gamma$ and $\theta$ are vectors of parameters to be estimated; $X_i$ is a vector of variables that collects personal individual characteristics of each individual/household (age, sex, education level...) and $Z_i$ is a vector of variables that reflect the main economic determinants of consumption (income, real wealth and financial wealth, expressed in logarithms); $UNC_i$ is the uncertainty measure ; $v_i$ is an error term assumed independently and identically distributed. This equation is estimated by OLS (see Caroll 1994; Lusardi 1997; Miles 1997; Guariglia and Rossi 2002; Deidda 2013; or Estrada *et al*. 2014; among others).[81, 82]

The income variable included in the model is the income of the household reference person in the year prior to the survey, given that our uncertainty measures are defined in relation to this reference person. We include the income of the previous year and not of the current year by homogeneity in the data. The interviews for the survey are conducted in different moments of time and, therefore, households respond at the time of the interview what their "regular monthly" income is. Thus, to avoid assuming that current income is the same throughout the year of the interview, we use the income of the previous year which is the last known yearly income. The respondents report their total income (in different categories) in the calendar year preceding the survey (2007 or 2010, in each case).[83]

A set of variables comprising individual and family characteristic are also included in addition to income and wealth. These variables are the size or composition of the family (see, for example Skinner 1988; Lusardi 1993, 1997; or Banks *et al*. 2001), whether there are

[81] We take the variables in logarithms to eliminate the effect of the different units of measure in which they are expressed.

[82] All variables related to income, wealth, debt and expenditures are expressed in 2011 euros using the Consumer Price Index (CPI) as deflator. To adjust assets and debts to 2011 euros, the data from the EFF2008 have been multiplied by 1.0741. To adjust the household income for the calendar year prior to the survey to 2011 euros, factors were 1.0780 for 2008 and 1.0238 for 2011 (Banco de España, 2014).

[83] Although we are only considering employees, the income variable comprises all incomes they declare that have earned in the previous year and not just salary or extra payments received.

children at home (as in Miles 1997; Kazarosian 1997; Lusardi 1997; Carroll and Samwick 1998; or Guariglia and Kim 2003) and the number of recipients of income, which in our case refers to the number of adults with a job (Dynan 1993; Lusardi 1998; or Guariglia and Kim 2003; among others). Other variables that reflect personal characteristics are age, gender, marital status, health or education level (see, for example, Guiso et al. 1996; Kazarosian 1997; Carroll and Samwick 1998; Lusardi 1998; Guariglia 2001; Benito 2006; or Deidda 2013).

Equation (2.1) is initially estimated by OLS for separate waves of the survey, namely 2008 and 2011. Thus, we are able to analyse whether results change in two different moments of time characterised by completely different macroeconomic contexts. However, the OLS estimation by waves may be flawed due a sample selection bias. Given that we have selected households where the reference person is an employee (in order to explore the impact of labour income uncertainty on saving decisions) there could be some factors that lead individuals to become employees instead of self-employed and that could affect consumption. Also, some individuals could switch labour status from one wave to the other (employee to self-employed, for instance), and therefore they would be included in one sample but not on the other. Thus, in the OLS estimations we cannot control for these time-invariant factors that affect occupational choices of individuals. To explore the potential impact of these issues on our results we exploited the panel component of the survey, and estimate an additional model including individual fixed-effects.[84] In this panel estimation, the households included in the regressions (704) are those whose reference person is the same in both years.

In order to analyse and interpret the results it is necessary to overview the different macroeconomic context in which they are estimated. In general terms, 2008 is characterized by high private debt (the household debt as a percentage of GDP reached 83% in 2007),

[84] These time invariant effects could also affect wealth accumulation, either real of financial, which in turn could introduce potential endogeneity problems with these wealth variables. Thus, the panel estimation with fixed effects also accounts for this potential endogeneity problem. We acknowledge one of the reviewers for this important insight.

the absence of liquidity constraints (by 2008, before the financial meltdown, the Spanish banking system had completed a wild competition process, fuelled by the housing bubble: commercial and saving banks had competed for new clients using mortgages and personal loans as a commercial vehicle, hence the wide availability of cheap credit) and a very low (for the Spanish standards) unemployment rate (in 2007 the unemployment rate stood at the 30-years low 8.2%, rising to 11.2% in 2008). On the contrary, 2011 is characterized by a high and rising unemployment rate (almost doubled since 2008, reaching 21.4%). The private debt in terms of GDP continued to increase during the first years of the crisis due to the negative performance of aggregate production, reaching its peak in 2010. In addition, the strong restructuring of the banking sector, forced by the financial meltdown, led commercial banks to restrain credit, limiting the ability of households to borrow. Our econometric results are consistent with these differences in the macroeconomic context.

We begin by analysing the impact of subjective uncertainty measures on household consumption. Table 2.2 summarises the empirical results. Columns (1), (4) and (8) provide a baseline scenario in which we estimate the consumption model without any uncertainty measure. Columns (2) and (3) summarise the results for 2008 including the two available measures, the negative expectations about future household income and the expectations about losing the job in the next twelve months, (denoted as "*Negative Y expectations*" and "*Losing job*", respectively), while columns (5) to (7) report the estimated coefficients for 2011 with the available measures, the negative expectations about future household income, the squared probability of losing the job in the next twelve months and the variance of expected labour income ("*Negative Y expectations*", "$p^2$ *of losing job*" and "*Variance of expected labour Y*").

Table 2.2. OLS and FE estimates with different subjective measures of uncertainty

| | 2008 | | | 2011 | | | | PANEL | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Without | Negative Y expectations | Losing job | Without | Negative Y expectations | p² of losing job | Variance of expected labor Y | Without | Negative Y expectations |
| ln(Y) | 0.017 | 0.017 | 0.015 | 0.042*** | 0.042*** | 0.040*** | 0.042*** | -0.020 | -0.020 |
| | (0.014) | (0.014) | (0.014) | (0.010) | (0.010) | (0.010) | (0.010) | (0.026) | (0.026) |
| ln(RW) | 0.023*** | 0.023*** | 0.023*** | 0.012** | 0.012** | 0.012** | 0.012** | 0.015 | 0.015 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.009) | (0.009) |
| ln(FW) | 0.015* | 0.014* | 0.014* | 0.017*** | 0.017*** | 0.017** | 0.017*** | 0.017* | 0.017* |
| | (0.008) | (0.008) | (0.008) | (0.007) | (0.007) | (0.007) | (0.007) | (0.010) | (0.010) |
| 0 < Debt/HY < 3 | -0.036 | -0.036 | -0.036 | 0.028 | 0.028 | 0.029 | 0.030 | -0.101** | -0.101** |
| | (0.040) | (0.040) | (0.040) | (0.037) | (0.037) | (0.037) | (0.037) | (0.044) | (0.044) |
| Debt/HY >= 3 | -0.116* | -0.115* | -0.117* | -0.266*** | -0.268*** | -0.269*** | -0.267*** | -0.214*** | -0.214*** |
| | (0.061) | (0.061) | (0.061) | (0.047) | (0.047) | (0.047) | (0.047) | (0.083) | (0.082) |
| Credit constraints | 0.050 | 0.048 | 0.051 | -0.098* | -0.098** | -0.092* | -0.099** | -0.059 | -0.059 |
| | (0.079) | (0.079) | (0.078) | (0.050) | (0.050) | (0.050) | (0.050) | (0.076) | (0.076) |
| Risk aversion | -0.065 | -0.063 | -0.062 | -0.050 | -0.050 | -0.051 | -0.052 | -0.054 | -0.053 |
| | (0.042) | (0.042) | (0.042) | (0.039) | (0.039) | (0.039) | (0.039) | (0.045) | (0.045) |
| Two adults working | 0.176*** | 0.178*** | 0.177*** | 0.117*** | 0.117*** | 0.114*** | 0.118*** | 0.114** | 0.114** |
| | (0.042) | (0.042) | (0.042) | (0.035) | (0.035) | (0.035) | (0.035) | (0.047) | (0.047) |
| Three or more adults working | 0.284*** | 0.286*** | 0.284*** | 0.409*** | 0.407*** | 0.410*** | 0.408*** | 0.053 | 0.052 |
| | (0.073) | (0.073) | (0.073) | (0.066) | (0.066) | (0.065) | (0.066) | (0.077) | (0.077) |
| Minors | 0.057 | 0.056 | 0.055 | 0.155*** | 0.154*** | 0.154*** | 0.154*** | 0.088 | 0.088 |
| | (0.039) | (0.039) | (0.038) | (0.034) | (0.033) | (0.033) | (0.034) | (0.059) | (0.059) |
| Employee & self_employed | -0.173 | | | -0.031 | | | | -0.005 | |
| | (0.146) | | | (0.092) | | | | (0.133) | |
| Age | 0.005** | 0.005** | 0.005** | 0.009*** | 0.009*** | 0.009*** | 0.008*** | 0.035 | 0.035 |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.028) | (0.028) |
| Man | 0.044 | 0.042 | 0.043 | -0.035 | -0.035 | -0.035 | -0.036 | | |
| | (0.037) | (0.037) | (0.037) | (0.035) | (0.035) | (0.035) | (0.035) | | |
| Couple | 0.149*** | 0.149*** | 0.148*** | 0.157*** | 0.156*** | 0.158*** | 0.155*** | 0.059 | 0.059 |
| | (0.047) | (0.047) | (0.047) | (0.040) | (0.040) | (0.040) | (0.040) | (0.092) | (0.092) |
| Primary education | 0.020 | 0.019 | 0.023 | -0.089* | -0.088* | -0.082* | -0.086* | -0.084 | -0.084 |
| | (0.046) | (0.046) | (0.047) | (0.047) | (0.047) | (0.046) | (0.047) | (0.054) | (0.053) |
| College | 0.211*** | 0.210*** | 0.212*** | 0.106*** | 0.107*** | 0.100** | 0.104*** | 0.122 | 0.121 |
| | (0.042) | (0.042) | (0.042) | (0.040) | (0.040) | (0.040) | (0.040) | (0.093) | (0.093) |
| **Uncertainty measure** | | **0.023** | **-0.053** | | **-0.032** | **-0.104** | **-0.002** | | **-0.007** |
| | | (0.051) | (0.065) | | (0.036) | (0.066) | (0.002) | | (0.037) |
| Dummy2011 | | | | | | | | -0.139* | -0.138* |
| | | | | | | | | (0.079) | (0.080) |
| constant | 8.466*** | 8.470*** | 8.483*** | 8.132*** | 8.131*** | 8.192*** | 8.173*** | 7.742*** | 7.742*** |
| | (0.168) | (0.167) | (0.167) | (0.140) | (0.139) | (0.144) | (0.147) | (1.364) | (1.364) |
| **r2_a** | **0.2131** | **0.2124** | **0.2129** | **0.3309** | **0.3316** | **0.3333** | **0.3317** | | |
| **r2_between** | | | | | | | | **0.2301** | **0.2303** |
| **r2_within** | | | | | | | | **0.0577** | **0.0577** |
| **r2_overall** | | | | | | | | **0.1894** | **0.1896** |
| **N** | **1844** | **1844** | **1844** | **1671** | **1671** | **1671** | **1671** | **1408** | **1408** |

Notes: Coefficient estimates. Cluster robust standard errors in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.1. The households included in the OLS regressions are those for which all uncertainty measures could be constructed. The households included in the FE regressions are those for which the reference person is the same in both waves.

In general, the results for the standard control variables are in line with previous analysis, with expected signs. Wealth impacts positively on consumption, and the household characteristics show the expected

relations.[85] Additionally, the estimated coefficients are, in general, robust to the specification as regards the inclusion of different uncertainty measures, even though they differ in magnitude in the two waves. This is especially interesting as regards wealth variables. Real wealth shows greater coefficients in 2008 (0.023) than in 2011 (0.012), whereas financial wealth has greater coefficients in 2011, and is only significant at the 90% in 2008. Contrary to the predictions of standard models of consumption, income is not significant in 2008, turning to significant coefficients in 2011. We interpret this joint result as the outcome of the macroeconomic context outlined above. In 2008 the household wealth had been substantially increased, mainly real wealth through the increase in real estate prices due to the housing boom. This growth of wealth, coupled with the absence of liquidity constraints may explain why in 2008 income is not significant. Households had purchasing power via wealth and borrowing against their price-increasing real assets. However, in 2011, as a result of the burst of the housing bubble, real estate prices fell dramatically, hence decreasing the value of real wealth. Additionally, households tended to accumulate financial assets.[86] This would explain why the two variables of wealth are significant and robust to the type of specification, but the coefficient of real wealth is much lower in 2011 than in 2008. Due to the loss of real wealth and the existence of strong credit restrictions, in 2011 income becomes an important determinant of consumption, being, together with financial wealth, the main source of purchasing power. Moreover, the elasticity of income remains more or less stable, which means that the estimated parameter is robust to the type of specification. We have also included a dummy variable

[85] The credit constraint variable is a dummy equal to one when the household reports he/she has been denied a loan or has been granted a loan for an amount less than that he/she requested for during the last two years, or that he/she has not applied for a loan on the belief that the application would be turned down.

[86] According to the Bank of Spain, compared to the first quarter of 2009, in the first quarter of 2011 the percentage of Spanish households with any type of financial asset was greater (and the increase in this percentage was higher in the lower half of the wealth distribution). For families with some kind of financial asset, the median value of these assets increased by 23.1%. See Banco de España (2014).

measuring risk aversion,[87] but although having a negative coefficient, this subjective variable is not significant in any specification.

As regards the analysis of precautionary savings none of the subjective uncertainty measures seem to exert a significant effect on consumption, neither in the individual wave estimation nor in the panel specification. Starting with the household expectations about future income ($Negative\ Y\ expectations$), (columns (2), (5) and (9) in Table 2.2), this variable is not significant in any year. As explained above, we constructed a second subjective uncertainty measure for 2008, a binary variable taking value 1 if the reference person of the household believes he/she will lose his job in the forthcoming 12 months ($Losing\ job$). The regression with this variable resulted in a non-significant effect, most likely due to a low self-perceived risk of job loss during the strongest business cycle of the Spanish economy in the last 40 years. For 2011 we constructed two additional uncertainty measures. Firstly, we use the squared probability of the self-perceived probability of losing the job in the next 12 months, $p^2\ of\ losing\ job$ (column (6) in Table 2.2). Given the non-significance of this measure, we also computed the variance of the expected income from the subjective probability of being unemployed in the next 12 months ($Variance\ of\ expected\ labour\ Y$) and estimated the model accordingly. Results, summarised in column (7) of Table 2.2 suggest that this subjective measure of uncertainty is not significant either. The panel specification also confirms the lack of significance of subjective uncertainty measures. In this case, the only available measure for both waves is the household expectations about future income, which also presents a negative but non-significant coefficient. Therefore, the general image that emerges from this first set of econometric results is that subjective uncertainty measures play no role in the explanation of consumption patterns of the households included in our sample, which would reject the hypothesis of a precautionary saving motive. These results are in line with those of

[87] This dummy variable takes value one when households report they are not willing to take on financial risk when they make an investment, zero otherwise.

Benito (2006) who does not find evidence of precautionary savings in UK using the subjective probability of losing the job.

Mastrogiacomo and Alessie (2014) highlight that the small impact of precautionary savings found usually in the empirical literature when using subjective measures of uncertainty could be due to the shortcoming of taking into account only the uncertainty borne by the reference person. Thus, they also include in the analysis the uncertainty perceived by the second income earner, and check whether the results for objective and subjective uncertainty measures are similar. Their results show little difference between these uncertainty measures, and that both indicate that precautionary savings account for approximately 30% of savings in the Netherlands. We followed the same strategy as a robustness check, that is, we included also the uncertainty borne by the couple of the reference person, but results (displayed on Table 2.3) do not change: the subjective measures are not significant. Note that for this exercise we are reducing our sample to 774 and 648 households in 2008 and 2011, respectively. This occurs because in order to having into account the uncertainty borne by the reference person and his/her couple we are eliminating the household whose reference person has not a couple and also the households in which the couple of the reference person is not employee. For this same reason, we estimate only the OLS model and not the panel because of the great reduction of the sample if we consider among these 774 and 648 households only those who are in the panel component of the survey (about 400 households only).

Table 2.3. OLS estimates with different subjective measures of uncertainty for the reference person and his/her couple

| | 2008 | | | 2011 | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| | **Without** | **Negative Y expectations** | **Losing job** | **Without** | **Negative Y expectations** | **p² of losing job** | **Variance of expected labor Y** |
| ln(Y) | -0.002 | -0.002 | -0.002 | 0.055*** | 0.054*** | 0.054*** | 0.055*** |
| | (0.017) | (0.017) | (0.018) | (0.014) | (0.014) | (0.014) | (0.014) |
| ln(Ycouple) | 0.218*** | 0.216*** | 0.214*** | 0.114*** | 0.114*** | 0.109*** | 0.108*** |
| | (0.049) | (0.049) | (0.049) | (0.038) | (0.039) | (0.037) | (0.038) |
| ln(RW) | 0.015* | 0.015* | 0.015* | 0.001 | -0.001 | -0.001 | -0.000 |
| | (0.008) | (0.008) | (0.008) | (0.012) | (0.012) | (0.012) | (0.012) |
| ln(FW) | 0.010 | 0.010 | 0.011 | 0.034*** | 0.032*** | 0.031** | 0.031** |
| | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) |
| 0 < Debt/HY < 3 | -0.031 | -0.029 | -0.028 | -0.009 | -0.004 | -0.004 | -0.009 |
| | (0.063) | (0.063) | (0.060) | (0.053) | (0.052) | (0.052) | (0.054) |
| Debt/HY >= 3 | -0.059 | -0.055 | -0.063 | -0.220*** | -0.213*** | -0.217*** | -0.222*** |
| | (0.090) | (0.090) | (0.088) | (0.073) | (0.073) | (0.074) | (0.073) |
| Credit constraints | 0.118 | 0.115 | 0.125 | 0.008 | 0.007 | 0.012 | 0.002 |
| | (0.123) | (0.125) | (0.125) | (0.104) | (0.104) | (0.107) | (0.104) |
| Risk aversion | 0.021 | 0.021 | 0.022 | -0.101* | -0.104** | -0.106** | -0.108** |
| | (0.059) | (0.059) | (0.058) | (0.052) | (0.052) | (0.053) | (0.053) |
| Three or more adults working | 0.013 | 0.013 | 0.017 | 0.159** | 0.150** | 0.154** | 0.146** |
| | (0.089) | (0.089) | (0.090) | (0.072) | (0.073) | (0.071) | (0.072) |
| Minors | 0.063 | 0.062 | 0.060 | 0.127*** | 0.127*** | 0.130*** | 0.126*** |
| | (0.057) | (0.057) | (0.059) | (0.047) | (0.047) | (0.048) | (0.048) |
| Age | 0.001 | 0.001 | 0.001 | 0.014*** | 0.010* | 0.010* | 0.009* |
| | (0.007) | (0.007) | (0.007) | (0.003) | (0.006) | (0.006) | (0.006) |
| Age couple | 0.008 | 0.008 | 0.008 | | 0.005 | 0.005 | 0.005 |
| | (0.006) | (0.006) | (0.006) | | (0.005) | (0.005) | (0.005) |
| Man | 0.058 | 0.058 | 0.056 | | 0.429** | 0.426** | 0.421** |
| | (0.103) | (0.103) | (0.105) | | (0.178) | (0.178) | (0.177) |
| Man couple | -0.083 | -0.083 | -0.089 | 0.039 | 0.450** | 0.449** | 0.452** |
| | (0.105) | (0.106) | (0.107) | (0.051) | (0.184) | (0.185) | (0.185) |
| Primary education | 0.056 | 0.045 | 0.048 | -0.131* | -0.132* | -0.132* | -0.131* |
| | (0.077) | (0.077) | (0.077) | (0.068) | (0.068) | (0.069) | (0.069) |
| Primary education couple | 0.028 | 0.034 | 0.032 | -0.092 | -0.091 | -0.084 | -0.095 |
| | (0.073) | (0.073) | (0.074) | (0.061) | (0.061) | (0.063) | (0.061) |
| College | 0.095 | 0.097 | 0.097 | -0.027 | -0.021 | -0.024 | -0.022 |
| | (0.063) | (0.063) | (0.062) | (0.055) | (0.056) | (0.056) | (0.056) |
| College couple | 0.076 | 0.078 | 0.082 | 0.092 | 0.080 | 0.081 | 0.080 |
| | (0.076) | (0.076) | (0.071) | (0.057) | (0.058) | (0.057) | (0.058) |
| **Uncertainty household** | | **0.045** | | | **-0.004** | | |
| | | (0.068) | | | (0.055) | | |
| **Uncertainty reference person** | | | **0.074** | | | **-0.050** | **0.000** |
| | | | (0.114) | | | (0.117) | (0.003) |
| **Uncertainty couple** | | | **-0.159** | | | **-0.030** | **-0.002** |
| | | | (0.161) | | | (0.105) | (0.003) |
| constant | 6.827*** | 6.821*** | 6.856*** | 6.980*** | 6.589*** | 6.675*** | 6.696*** |
| | (0.523) | (0.524) | (0.513) | (0.391) | (0.440) | (0.434) | (0.452) |
| **r2_a** | **0.1788** | **0.1774** | **0.1808** | **0.3778** | **0.3761** | **0.3760** | **0.3769** |
| **N** | **774** | **774** | **774** | **648** | **648** | **648** | **648** |

Notes: Coefficient estimates. Cluster robust standard errors in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.1. The households included in the OLS regressions are those for which all uncertainty measures could be constructed and those whose reference person has a couple who is employee.

Given the lack of significance of the available subjective uncertainty measures we analyse the impact of two different objective measures, namely the unemployment rate and the job insecurity indicator, which are related to the probability of continuing to receive labour income in the future. Table 2.4 summarizes our results when we include the unemployment rate as the uncertainty measure. In this case we find that in the separate wave estimations this variable presents the expected negative sign, but it is only significant for 2011, with a coefficient of -1.696. We may interpret this result in the context of the macroeconomic performance of the Spanish economy during the recession. Unemployment was in 2007-2008 at its 30-year lowest value, and thus it did not generate uncertainty on consumption/saving decisions. Hence, the measure of uncertainty approximated by the unemployment rate assigned to the household's reference person is not significant for 2008. However, in 2011, due to the strong increase in the number of unemployed workers, expectations of further rises in the unemployment rate were present (in fact, the unemployment rate peaked to 26.1% two years later). Given the great job destruction that was taking place, the unemployment risk became an important source of uncertainty. Hence, the unemployment rate turns to be significant with a strong and negative value in consumption regressions for 2011. Mody *et al.* (2012), Bande and Riveiro (2013) or Estrada *et al.* (2014) find similar results as regards the existence of precautionary savings using the level of the unemployment rate in the first two cases, and its volatility in the latter. Campos *et al.* (2004), however, using the probability of becoming unemployed for the reference person in the household, find no evidence of precautionary savings. This result may be in line with our estimates for 2008, given that they analyse a period (1985-1995) in which the unemployment rate did not follow a defined pattern, with marked upswings and declines. Nevertheless, the results with the panel are discouraging as regards the validity of the unemployment rate as an adequate uncertainty measure, since the coefficient on the unemployment rate is now positive and significant, which goes against the theory. Recall that our unemployment measure is an average of five-year age groups and gender, and thus, it is rather gross in order to fine-tune the uncertainty borne by households

individually. Taking altogether, these results cast doubts on this objective measure of uncertainty, and reinforce our prior that rather than the unemployment risk, there may be other labour income risk sources that affect consumption/saving decisions. We turn now to the estimated models with the job insecurity indicator as the proxy for uncertainty.

Table 2.4. OLS and FE estimates with the unemployment rate as uncertainty measure

| | 2008 | | 2011 | | PANEL | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | **Without** | **Un rate** | **Without** | **Un rate** | **Without** | **Un rate** |
| ln(Y) | 0.017 | 0.018 | 0.042*** | 0.039*** | -0.020 | -0.021 |
| | (0.014) | (0.019) | (0.010) | (0.013) | (0.026) | (0.026) |
| ln(RW) | 0.023*** | 0.025*** | 0.012** | 0.015** | 0.015 | 0.012 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.009) | (0.010) |
| ln(FW) | 0.015* | 0.016** | 0.017*** | 0.020*** | 0.017* | 0.018* |
| | (0.008) | (0.007) | (0.007) | (0.006) | (0.010) | (0.010) |
| 0 < Debt/HY < 3 | -0.036 | -0.043 | 0.028 | 0.016 | -0.101** | -0.115*** |
| | (0.040) | (0.036) | (0.037) | (0.031) | (0.044) | (0.044) |
| Debt/HY >= 3 | -0.116* | -0.144** | -0.266*** | -0.312*** | -0.214*** | -0.229*** |
| | (0.061) | (0.057) | (0.047) | (0.030) | (0.083) | (0.081) |
| Credit constraints | 0.050 | 0.045 | -0.098* | -0.099** | -0.059 | -0.055 |
| | (0.079) | (0.091) | (0.050) | (0.038) | (0.076) | (0.075) |
| Risk aversion | -0.065 | -0.057 | -0.050 | -0.045 | -0.054 | -0.059 |
| | (0.042) | (0.035) | (0.039) | (0.035) | (0.045) | (0.044) |
| Two adults working | 0.176*** | 0.163*** | 0.117*** | 0.108*** | 0.114** | 0.111** |
| | (0.042) | (0.037) | (0.035) | (0.033) | (0.047) | (0.048) |
| Three or more adults working | 0.284*** | 0.294*** | 0.409*** | 0.445*** | 0.053 | 0.046 |
| | (0.073) | (0.076) | (0.066) | (0.075) | (0.077) | (0.078) |
| Minors | 0.057 | 0.029 | 0.155*** | 0.126** | 0.088 | 0.094 |
| | (0.039) | (0.038) | (0.034) | (0.045) | (0.059) | (0.060) |
| Employee & self_employed | -0.173 | | -0.031 | | -0.005 | |
| | (0.146) | | (0.092) | | (0.133) | |
| Age | 0.005** | | 0.009*** | | 0.035 | |
| | (0.002) | | (0.002) | | (0.028) | |
| Man | 0.044 | | -0.035 | | | |
| | (0.037) | | (0.035) | | | |
| Couple | 0.149*** | 0.163*** | 0.157*** | 0.154*** | 0.059 | 0.058 |
| | (0.047) | (0.043) | (0.040) | (0.041) | (0.092) | (0.092) |
| Primary education | 0.020 | 0.038 | -0.089* | -0.067* | -0.084 | -0.091* |
| | (0.046) | (0.055) | (0.047) | (0.038) | (0.054) | (0.054) |
| College | 0.211*** | 0.206*** | 0.106*** | 0.110** | 0.122 | 0.125 |
| | (0.042) | (0.035) | (0.040) | (0.051) | (0.093) | (0.094) |
| **Uncertainty measure** | | **-1.177** | | **-1.696**** | | **1.438**** |
| | | (0.789) | | (0.643) | | (0.727) |
| Dummy2011 | | | | | -0.139* | -0.157** |
| | | | | | (0.079) | (0.062) |
| constant | 8.466*** | 8.786*** | 8.132*** | 8.794*** | 7.742*** | 9.312*** |
| | (0.168) | (0.245) | (0.140) | (0.206) | (1.364) | (0.320) |
| **r2_a** | **0.2131** | **0.2065** | **0.3309** | **0.3206** | | |
| **r2_between** | | | | | **0.2301** | **0.3015** |
| **r2_within** | | | | | **0.0577** | **0.0612** |
| **r2_overall** | | | | | **0.1894** | **0.2412** |
| **N** | **1844** | **1844** | **1671** | **1671** | **1408** | **1408** |

Notes: Coefficient estimates. Cluster robust standard errors in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.1. The households included in the OLS regressions are those for which all uncertainty measures could be constructed. The households included in the FE regressions are those for which the reference person is the same in both waves.

Table 2.5 summarizes the results of the estimation of our consumption models with this new uncertainty measure. Columns (2) and (4) show that this indicator has the expected negative sign, being significant for both waves. Thus, while the coefficient takes the value -0.096 in 2008 it falls to a significant value of -0.070 in 2011. A high value for the job insecurity indicator implies that the working conditions are poor, i.e., the individual has a job with bad conditions and precarious stability, which translates into a greater risk of losing it. Barceló and Villanueva (2010) use as a measure of uncertainty the type of contract of the reference person and find evidence for precautionary savings in Spain. Our measure is more complete since it adds others sources of job instability, which may reinforce or mitigate the effect of the type of contract alone, such as seniority in the company, the size of the firm, whether the individual was unemployed or not during the previous year, etc. Our results point in the same direction than those of Barceló and Villanueva (2010). Although unemployment may be low, the labour conditions that the individuals face in the workplace may become a source of uncertainty. For instance, individuals with a worse situation, e.g., on a temporary contract, without seniority, etc., perceive greater uncertainty about their future job situation than others with greater job security. Therefore, in 2008 the indicator of job insecurity is significant. In 2011 this measure is still important but not as relevant as in 2008. We interpret this result as the outcome of the great job destruction that was taking place: uncertainty affected all types of work, and even being in a "good" and stable job was not a guarantee to avoid dismissals, and therefore many workers did not feel secure in their job, and saved "for a rainy day". The panel estimation reinforces this result. Even though many controls become non-significant when we estimate the panel with individual fixed effect (especially income and wealth, which may be explained along the lines of the changes in the macroeconomic context, note the negative coefficient of the time fixed effect), the conclusion as regards the role of the job insecurity indicator as an adequate measure of uncertainty in consumption models is maintained. The estimated coefficient is negative and significant (-0.085). Therefore, we conclude that our empirical results

support the view of the existence of precautionary savings among the households in our sample, and that job characteristics (summarised in our job insecurity indicator) measure more adequately the uncertainty about future labour income than a rather aggregated labour market measure as the unemployment rate.

Table 2.5. OLS and FE estimates with uncertainty measured trough the job insecurity indicator

| | 2008 | | 2011 | | PANEL | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Without | Job insecurity indicator | Without | Job insecurity indicator | Without | Job insecurity indicator |
| ln(Y) | 0.017 | 0.005 | 0.042*** | 0.031*** | -0.020 | -0.022 |
| | (0.014) | (0.014) | (0.010) | (0.010) | (0.026) | (0.025) |
| ln(RW) | 0.023*** | 0.020*** | 0.012** | 0.011** | 0.015 | 0.014 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.009) | (0.009) |
| ln(FW) | 0.015* | 0.012 | 0.017*** | 0.013* | 0.017* | 0.017* |
| | (0.008) | (0.008) | (0.007) | (0.007) | (0.010) | (0.010) |
| 0 < Debt/HY < 3 | -0.036 | -0.044 | 0.028 | 0.025 | -0.101** | -0.102** |
| | (0.040) | (0.040) | (0.037) | (0.037) | (0.044) | (0.044) |
| Debt/HY >= 3 | -0.116* | -0.119* | -0.266*** | -0.266*** | -0.214*** | -0.212** |
| | (0.061) | (0.061) | (0.047) | (0.047) | (0.083) | (0.082) |
| Credit constraints | 0.050 | 0.056 | -0.098* | -0.085* | -0.059 | -0.061 |
| | (0.079) | (0.077) | (0.050) | (0.050) | (0.076) | (0.076) |
| Risk aversion | -0.065 | -0.061 | -0.050 | -0.051 | -0.054 | -0.053 |
| | (0.042) | (0.042) | (0.039) | (0.039) | (0.045) | (0.045) |
| Two adults working | 0.176*** | 0.172*** | 0.117*** | 0.127*** | 0.114** | 0.114** |
| | (0.042) | (0.043) | (0.035) | (0.035) | (0.047) | (0.047) |
| Three or more adults working | 0.284*** | 0.280*** | 0.409*** | 0.427*** | 0.053 | 0.057 |
| | (0.073) | (0.072) | (0.066) | (0.064) | (0.077) | (0.077) |
| Minors | 0.057 | 0.051 | 0.155*** | 0.148*** | 0.088 | 0.088 |
| | (0.039) | (0.038) | (0.034) | (0.034) | (0.059) | (0.059) |
| Employee & self_employed | -0.173 | | -0.031 | | -0.005 | |
| | (0.146) | | (0.092) | | (0.133) | |
| Age | 0.005** | 0.005* | 0.009*** | 0.008*** | 0.035 | 0.032 |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.028) | (0.029) |
| Man | 0.044 | 0.028 | -0.035 | -0.035 | | |
| | (0.037) | (0.037) | (0.035) | (0.035) | | |
| Couple | 0.149*** | 0.157*** | 0.157*** | 0.157*** | 0.059 | 0.048 |
| | (0.047) | (0.049) | (0.040) | (0.040) | (0.092) | (0.092) |
| Primary education | 0.020 | 0.042 | -0.089* | -0.079* | -0.084 | -0.084 |
| | (0.046) | (0.047) | (0.047) | (0.046) | (0.054) | (0.052) |
| College | 0.211*** | 0.194*** | 0.106*** | 0.098** | 0.122 | 0.119 |
| | (0.042) | (0.042) | (0.040) | (0.040) | (0.093) | (0.092) |
| **Uncertainty measure** | | **-0.096*** ** | | **-0.070*** ** | | **-0.078*** |
| | | (0.031) | | (0.025) | | (0.044) |
| Dummy2011 | | | | | -0.139* | -0.134* |
| | | | | | (0.079) | (0.081) |
| constant | 8.466*** | 8.971*** | 8.132*** | 8.541*** | 7.742*** | 8.129*** |
| | (0.168) | (0.225) | (0.140) | (0.197) | (1.364) | (1.384) |
| **r2_a** | **0.2131** | **0.2224** | **0.3309** | **0.3379** | | |
| **r2_between** | | | | | **0.2301** | **0.2492** |
| **r2_within** | | | | | **0.0577** | **0.0619** |
| **r2_overall** | | | | | **0.1894** | **0.2053** |
| **N** | **1844** | **1844** | **1671** | **1671** | **1408** | **1408** |

Notes: Coefficient estimates. Cluster robust standard errors in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.1. The households included in the OLS regressions are those for which all uncertainty measures could be constructed. The households included in the FE regressions are those for which the reference person is the same in both waves.

As a final robustness check we finally test the effect of the macroeconomic context on household consumption/saving behaviour, pooling the information for both years into a single dataset, and estimating the model for this extended sample without any uncertainty measure with an indicator variable taking value 1 in 2011. Therefore, if this time fixed effect is significant with a negative sign, it would support our assumption that changes in the macroeconomic context affect consumption/saving decisions. Table 2.6 shows the result of this robustness analysis. As can be seen, the year dummy is significant and has a negative coefficient, providing thus support to our assumption about the effect of the macroeconomic context on consumption.[88]



[88] We also run the regressions for the whole sample, pooling observations of both waves, including interaction terms between time and uncertainty indicators. Results do not change for the uncertainty variables: the significant uncertainty proxies are the objective variables.

Table 2.6. Effect of the macroeconomic context on household consumption

| | (1) |
|---|---|
| | **Without** |
| ln(Y) | 0.027*** |
| | (0.009) |
| ln(RW) | 0.018*** |
| | (0.004) |
| ln(FW) | 0.017*** |
| | (0.005) |
| 0 < Debt/HY < 3 | -0.006 |
| | (0.028) |
| Debt/HY >= 3 | -0.195*** |
| | (0.040) |
| Credit constraints | -0.017 |
| | (0.047) |
| Risk aversion | -0.059** |
| | (0.030) |
| Two adults working | 0.152*** |
| | (0.028) |
| Three or more adults working | 0.327*** |
| | (0.053) |
| Minors | 0.107*** |
| | (0.026) |
| Employee & self_employed | -0.092 |
| | (0.079) |
| Age | 0.007*** |
| | (0.002) |
| Man | 0.006 |
| | (0.027) |
| Couple | 0.146*** |
| | (0.031) |
| Primary education | -0.028 |
| | (0.033) |
| College | 0.165*** |
| | (0.030) |
| **Dummy2011** | **-0.078*** ** |
| | (0.024) |
| constant | 8.352*** |
| | (0.114) |
| **r2_a** | **0.2560** |
| **N** | **3515** |

Notes: Coefficient estimates. Robust standard errors in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.10.

## 2.6. CONCLUDING REMARKS

In general, the evidence found on this chapter supports the existence of a precautionary saving motive among the Spanish households, and adds to the existing literature on this topic by providing new estimates based on different uncertainty sources. The magnitude of the effect that uncertainty has on household consumption varies depending on the considered measure of uncertainty, and the most appropriate measure in each case varies with the macroeconomic context.

Our findings suggest that subjective uncertainty measures do not provide any supportive evidence of a precautionary saving motive. Among the objective measures included in our econometric models, it seems that the job insecurity indicator serves as an adequate uncertainty measure, while the unemployment rate provides mixed results, dependent on the time period or econometric specification. We interpret this result as the outcome of the combination of a high and persistent jobless rate (which has never fell below 7%, even in the best years of the previous expansionary business cycle), an extremely persistent distribution of personal characteristics within our sample, especially as regards unemployment risk, and an imperfect unemployment risk assignment in our empirical model, since we are using 5-year average unemployment rates. The job insecurity indicator, in addition of being an individual measure not affected by assignment biases, measures more dimensions than just unemployment risk, which may exert a significant effect on consumption and saving decisions: the type of contract, seniority (which determines firing costs, and therefore employment protection), size of the firm, etc. Our empirical results suggest that this is the case, with a clear negative effect on consumption decision, regardless of the econometric specification.

These results may be helpful for the design of economic policy. On the one hand, they suggest that labour market reforms that tend to weaken the position of workers as regards job security are likely to impact negatively on aggregate demand, through falls in consumption. This is especially relevant in a highly indebted economy, as the

Spanish one, where additional savings could be used to cancel out debts instead of being directed towards investment. Also, it may be concluded that keeping a low and stable unemployment rate in the economy is not only an economic target *per se*, but would help in reducing the volatility of the saving rate of households.

# 3. PRECAUTIONARY SAVING IN SPAIN: EVIDENCE USING PANEL DATA

## 3.1. INTRODUCTION

This chapter tests the effect that income uncertainty has on household consumption using panel data for Spanish households. As mentioned in the previous chapter, it is an official survey provided by the Bank of Spain which contains information about different aspects of the economic and financial situation of Spanish households for several years.

The existence and strength of the precautionary motive for saving, as well as which is the most appropriate measure to proxy the uncertainty, is an unresolved question in the empirical literature testing the precautionary saving hypothesis (for a survey about precautionary saving see Browning and Lusardi, 1996; or Attanasio and Weber, 2010).

Three approaches to estimate the importance of precautionary saving have been used in empirical works: reduced for estimates, simulation models and subjective expectations. This chapter follows the first approach and uses objective data to estimate income risk. In particular, the analysis is framed in the empirical works which proxy income uncertainty using observed life-cycle income variation and the variability of income (Kazarosian, 1997; Carroll and Samwick, 1998; Guariglia, 2001; Ventura and Eisenhauer, 2006).

The main feature of this chapter is to provide evidence about precautionary saving in Spain exploiting the panel component of the survey for deriving a measure of income risk using the individual data on income for a period of 8 years. The analysis is performed in two steps. In a first step we estimate a measure of income risk based on panel data from 2007 to 2014. In particular, we calculate the average

household real income over the period and its standard deviation for each household as proxies of household normal income and income uncertainty, respectively. Related to this we show that this measure correlates with some variables that are commonly thought to be related to risk, like self-employment, age, etc. In a second step, we relate the variable of income uncertainty to consumption, testing whether uncertainty affects household consumption in 2014, the last available year of the survey.

The main contribution of this chapter is to provide evidence about precautionary in Spain. Since our econometric results show a negative impact of uncertainty on household consumption we can conclude about the evidence of the existence of precautionary saving in Spain. This is an important contribution because, although most empirical works find evidence of an effect of uncertainty on savings, not in many countries there is evidence about this motive for saving (US, Italy, UK, Germany and few others).

In the case of Spain, there is not too much evidence about precautionary saving and the majority of the papers proxy the uncertainty trough unemployment risk. Albarrán (2000) uses micro-data from a rotating panel, the Spanish Family Expenditure Survey, to analyse precautionary saving associated with income risk. He finds that cohort-specific risk and aggregate risk affect consumption growth. Barceló and Villanueva (2010) using data from the EFF find evidence in favour to the existence of precautionary savings proxying the probability of losing employment by the type of contract that the main recipients of income at household has. In a following paper, Barceló y Villanueva (2016), using the same survey, find that older workers covered by fixed-term contracts accumulate more financial wealth than other workers. Campos and Reggio (2015), using consumption panel data, find that households reduce consumption in response to the realization of negative news on future income growth contained in the unemployment rate. In the previous chapter, using also the Spanish EFF (and the Labour Force Survey), we find that subjective measures tend to generate a non-significant impact on consumption, and show that the impact of the objective measures is different depending on the moment of the business cycle. The

uncertainty measured through the jobless rate becomes an important source of income uncertainty only in a context when it is high and rising while, on the contrary, the job insecurity measure is significant at all business cycle horizons as well as regardless of the econometric specification.

So that, to the best of my knowledge, is the first time providing evidence about precautionary saving in Spain measuring income uncertainty from observed household real income data during a period of time.

We obtain that the results weakly differ depending on the consumption variable used as dependent variable in our model. When using the logarithm of the household consumption we obtain that an increase of 1% in the income uncertainty will decrease consumption in about 7%, however using the ratio between consumption and average income the effect is lower, given the average normal income and consumption in the sample, consumption will decrease by 5%.

After this introduction, the chapter is organized as follows. Section 3.2 briefly summarizes the existing literature about precautionary saving and the available empirical evidence for Spain. Section 3.3 provides a description of the constructed uncertainty measure and shows that this measure correlates with some variables that are commonly thought to be related to risk. Section 3.4 presents the econometric model and the results. Finally, Section 3.5 concludes.

## 3.2. REVIEW OF THE LITERATURE

When consumption decisions are made under uncertainty, and individuals are prudent and seek protection from risk, there is a significant negative impact on current consumption. Under some specific properties of the utility function (utility is increasing and concave and marginal utility is convex) uncertainty generates a positive extra-saving, the so-called "precautionary saving" (Leland, 1968).

The relevance of this motive for saving is an issue addressed mainly empirically. In spite of a large number of studies, the empirical

findings have yielded mixed results. The results range from no significant influence of the precautionary saving motive to the accumulation of wealth (Skinner, 1988; Dynan, 1993) to a small influence between 1%-4.5% (Guiso et al., 1992; Lusardi, 1997, 1998) and to results up to more than 50% (Dardanoni, 1991; Carroll and Samwick, 1998).

Moreover, in empirical literature there is no consensus about the intensity of the precautionary reason for saving, nor on which is the most appropriate measure to approximate the uncertainty. Three approaches to estimate the importance of precautionary saving have been used in empirical works: reduced for estimates, simulation models and subjective expectations. Works following the first approach attempts to estimate the impact of income risk on the reduced forms of consumption or wealth; that is, to estimate reduced form equations inspired by the PIH model with a role for precautionary saving. This approach also provides evidence in favour or against precautionary saving but does not deliver estimates of the parameters of the utility function (such as the coefficient of relative prudence).

Studies following the second approach estimate the paths of consumption and wealth in models with precautionary saving, matching simulated data to observed wealth and consumption distributions. Structural estimations deliver estimates of the parameters of the utility function but require the utility function, the budget constraint, the sources of risks, and the income process to be specified. Pioneering in this approach are Gourinchas and Parker (2002) and Cagetti (2003) who calibrate an explicit life cycle optimization problem using empirical data on the magnitude of household-level income shocks, and search econometrically for the values of parameters such as the coefficient of relative risk aversion that maximized the model"s ability to fit some measured feature of the empirical data. The intensity of the precautionary motive emerges, in each case, as an estimate of the coefficient of relative risk aversion.

Another direct strategy to analyse the existence of precautionary saving is the use of subjective expectations from survey questions data

(Lusardi, 1997; Guiso et al., 1992; or Mastrogiacomo and Alessie, 2014). The literature based on subjective expectations attempts to avoid the problem of lack of information that is not observed by the econometrician by asking people to report quantitative information on their expectations. This literature relies on survey questions to elicit information on the conditional distribution of future income, and measures shocks as deviations of actual realizations from elicited expectations. Hayashi (1985) is the first study to adopt this approach. Another use to subjective expectations is to measure expected consumption growth and expected consumption risk in Euler equation with precautionary saving using survey data that record respondents" own assessments of these variables. This is an alternative method to the simulation models to directly test precautionary saving through the estimation of the relative prudence coefficient.

The analysis carried out in this chapter is framed within the empirical works which proxy income uncertainty using observed life-cycle income variation (Kazarosian, 1997; Carroll and Samwick, 1998; Guariglia, 2001; Ventura and Eisenhauer, 2006). In particular, the uncertainty is proxied through the income variability following the first mentioned approach (reduced for estimates) and using objective data to estimate income risk. Since the main prediction of the precautionary saving model, with respect to the life cycle–permanent income model, is that saving and wealth are related not only to the first moment, but also to higher moments of income, a wide branch of the literature has estimated uncertainty by the income variability. Consumers accumulate not only to offset future declines in income, but also to insure against income risk, proxied traditionally by the standard deviation or the variance of income. There have been several methods to deal with the measurement of income risk in the works using objective micro data.

A popular method with cross-section data is to use an aggregate estimate of income variance by categorizing sample observations into groups according to socio-economic characteristics, e.g., occupation, age, education, etc. (Dardanoni, 1991). The within-group income variance is then used as a proxy for individual income variance (Dardanoni, 1991; Miles, 1997; or Mishra et al., 2013; follow this

approach). To be valid, this method requires assuming that each individual relies on the same set of variables to form expectations and that the individuals and the econometrician have the same information set. Miles (1997) calculates the variance of income and its standard deviation like measure of uncertainty based on a household"s characteristics and on the estimated cross-section relations between characteristics and the (square of) the unforecastable component of income and finds a strong precautionary saving from U.K. data. Also Dardanoni (1991) finds that around 60% of saving in UK is due to precautionary motives, he groups the households according to economic occupations and calculates the variance of labour income levels within each group as uncertainty measure. Mishra et al. (2013) provide the evidence of precautionary savings among self-employed farm households in US but they obtain that the percentage of total farm household wealth accumulated as a result of precautionary motive is only 8%. They categorize sample observations by operator's age, educational attainment, primary occupation, year in which the observations are made and farm typology and use the within-group income variance as a proxy for individual income variance.

Some works using panel data follow a similar method using not only the information from panel but also the individual characteristics in order to derive a measure of income risk (see Carroll, 1994; Kazarosian, 1997; or Guariglia and Rossi, 2002). Using a panel data from the National Longitudinal Survey (NLS) of U.S., Kazarosian (1997) approaches individual-specific income uncertainty with the standard deviation of the residual of each individual"s estimated age-log income profile. With panel data from the British Household Panel Survey (BHPS), Guariglia and Rossi (2002) calculate the variance of the earnings equation residuals in the years following as income volatility. The two works show evidence of precautionary saving. On the other hand, Carroll (1994), using Italian PSID data, measures uncertainty through the variance of normalized income and the standard deviation of normalized income (besides through the Equivalent Precautionary Premium (EPP) as (theoretical) measure of income uncertainty) and finds that all three measures decrease consumption with uncertainty arises.

When using micro panel data allows for a direct test whether people change their behaviour due to changes in risk according to theoretical predictions. For that, others works (Carroll and Samwick, 1998; Guariglia, 2001; or Ventura and Eisenhauer, 2006) exploit the panel structure of the data to calculate the permanent/normal income from the household real income over the considered period and the variance of this income. Carroll and Samwick (1998) include the log of the variance of the log of income as atheoretical measure of uncertainty (besides the log of relative Equivalent Precautionary Premium) and find that both coefficients are highly significant for all three measures of wealth considered (very liquid assets; non-housing non-business wealth and total net worth). Guariglia (2001) uses British Household Panel Survey (BHPS) data (years 1991 to 1998) to estimate three household specific measures of earnings uncertainty and test precautionary saving.[89] The first of them is obtained taking the square of the difference between detrended household earnings in 1991 and 1998 and dividing it by seven to have an annual rate. The second is the variance of income, $Y_t$, over the eight available waves (this measure assumes that all income shocks are transitory). The last measure is the variance of income over waves two to eight (variance of $Y_t - Y_{t-1}$ and contrary to previous assumes that all income shocks are entirely permanents). Guariglia concludes that there is a strong precautionary motive for saving for all measures of uncertainty employed. Ventura and Eisenhauer (2006) use the Survey of Household Income and Wealth (SHIW) to analyse three principal saving motives: intertemporal saving, bequest motive and precautionary saving.[90] They select households with income reported in both 1993 and 1995, and among them they focus only on savers. To capture the precautionary motive, for each household, they calculate

[89] Guariglia (2001), as in Lusardi (1998), also constructs an additional measure as a function of the subjective probability of job loss given for households.

[90] To investigate intertemporal saving, they divide this sample into two broad groups: those whose head of household is under age 65, and those whose head of household is 65 years of age or older. From these, they try to identify cohorts created on the basis of three characteristics of the head of the household: gender, education and area of residence. The difference in average income between young and old cohorts, is used as proxy for the intertemporal saving.

the average real income and its variance between these two years, which they use initially as proxies of current income and risk, respectively, in a saving equation. Then, exploiting the estimated regression coefficients as well as mean values of the variables, they calculate point estimates of absolute and relative prudence, and obtain that each young household saved 15.2% of its total annual saving by precautionary purposes.[91]

In this chapter we also make use of the panel component of the survey and perform the estimation in two stages. Firstly, exploiting the panel structure, we calculate the average household real income over the period and its standard deviation for each household. Then we use these variables as proxies of household normal income and income uncertainty, respectively, in a cross-sectional regression of consumption. The assumption under that is that individuals use their own past incomes to forecast their future income and have rational expectations. As pointed by Dynan (1993), the household consumption changes only in response to unexpected changes in income (Dynan 1993, pag. 1105) so, in this chapter we test the existence of precautionary saving analysing the effect of the uncertainty on consumption (see Dardanoni, 1991; Dynan; 1993; Carroll, 1994; Miles, 1997; Banks et al., 2001; or Benito, 2006; among others).

Although most empirical works find evidence of an effect of uncertainty on savings all these analysis are concentrated in the same economies so not in many countries there is evidence about precautionary saving (US, Italy, UK, Germany and few others).

This is not the first work providing evidence on precautionary saving in Spain. Albarrán (2000) uses micro-data from a rotating panel, the Spanish Family Expenditure Survey, to analyse precautionary saving associated with income risk. He finds that

[91] They also estimate an alternative measure of income risk linking real income to its social and demographic determinants, such as age, gender, education level, marital status, etc. as a measure of unpredictable income risk. From that, they estimate an income profile and proxy income risk for each household using the absolute percentage forecasting error getting that the share of total saving attributable to precautionary motives is about 36%.

consumption growth is not affected by household-specific risk but by cohort-specific and aggregate risk. Barceló and Villanueva (2010) using data from the EFF find evidence in favour to the existence of precautionary savings proxying the probability of losing employment by the type of contract that the main recipients of income at household has. In a following paper, Barceló y Villanueva (2016), using the same survey, analyse the effect the changes in severance payment have on wealth accumulation and find that older workers covered by fixed-term contracts accumulate more financial wealth than other workers. Campos and Reggio (2015), using consumption panel data, find that households reduce consumption in response to the realization of negative news on future income growth contained in the unemployment rate (calculated from the Spanish Labour Force Survey according to the level of education and age of the primary earner in the household). Also in the previous chapter we have shown that subjective measures generate a non-significant impact on consumption, and hence on saving, and the impact the objective measures have is different depending on the moment of the business cycle. Only in a context when unemployment is high and rising it becomes an important source of uncertainty while the job insecurity that the household reference person faces, generate a significant negative impact on consumption at all business cycle horizons as well as regardless of the econometric specification.

Thus, the evidence about precautionary saving in Spain is no so large. So that, the main contribution of this chapter is to provide empirical evidence about the effect the uncertainty has on consumption for the Spanish households. In addition, to the best of my knowledge, is the first work showing evidence about precautionary saving in Spain measuring income uncertainty from observed household real income data during a period of time.

### 3.3. MEASURING INCOME RISK FROM THE EFF DATA

In the context of precautionary motive for saving the use of microeconomic panel data is preferred to analyse consumption behaviour since allow capture the effects of individual income

uncertainty along a specific period. For this reason, to perform the analysis of precautionary saving in Spain we use the EFF data.[92] Since we have already included a section about the characteristics and methodology of this survey in the second chapter (section 2.3), in this chapter we directly focus in the variables needed for the specific analysis of it.

This chapter focuses in the panel component of the survey to analyse the existence and strength of precautionary saving in Spain. Since we want consider the normal income of the household, we work with a balanced panel including the households participating in the survey since 2008 for which eight years of income information is available.[93] The balanced panel comprises 1524 Spanish households.

The variable of household income is provided in the survey data and is constructed aggregating the data of individual income of household members, the income obtained from assets and the non-labour income received by the whole household. Therefore the income variable is the total gross income of the household, i.e. before taxes and social-security contributions. It comprises individual income of household members, income obtained from assets and non-labour income received by the whole household. When the household fails to provide a value for one of those components the Bank of Spain perform a direct imputation of the total. Two variables of total household income are included in the EFF data: one corresponding to the whole of previous year of the interview (2007, 2010 and 2013) and the other to the month in which the interview took place. Therefore, we proxy the annual household income during the year of the interview (2008, 2011 and 2014) multiplying the regular monthly income by 12 months.

[92] A description of the main variables used in the chapter is in Appendix B. In particular, Table B1 contains the list of variables used in the model and their description while Table B2 provides a descriptive table of the main characteristics of households in the sample.

[93] We could consider also the households participating since 2005 in order to have a wider period of analysis but doing that the sample is drastically reduced by half (876 households in the sample). For that, we have decided work with the household belonging to the panel from 2008 to 2014 but we provide also the results for the panel 2005-2014 in Appendix B, Table B3. The main results remain for the subset of households which are in the panel from 2005.

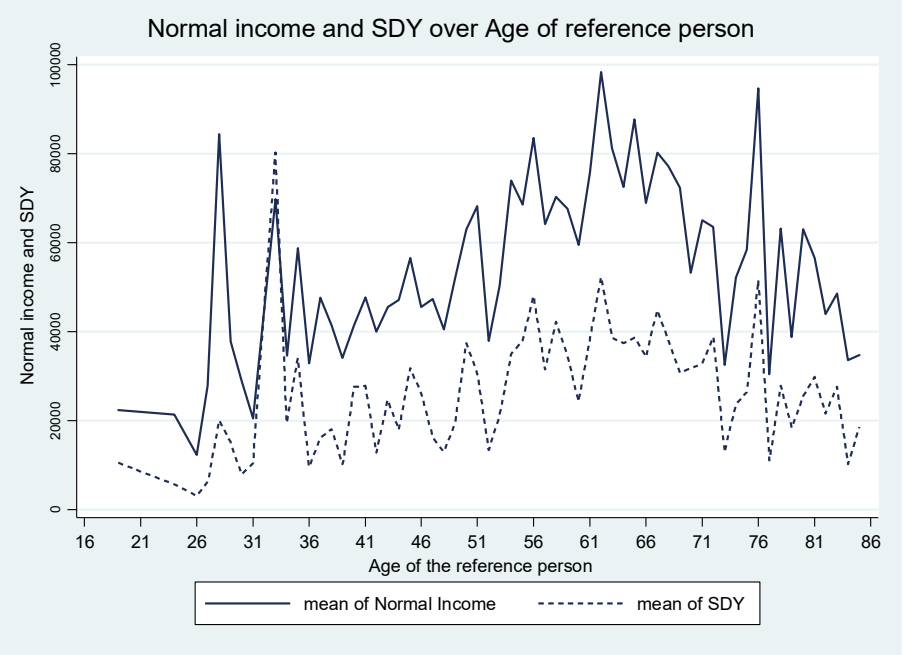
The income data are available for years 2007, 2008, 2010, 2011, 2013 and 2014 and expressed in real terms (2014 euros) using the Consumer Price Index (CPI) as deflator.[94] From this information exploiting the panel component we calculate the household average income over the whole period (2007-2014) and from that, calculate the standard deviation of the household income. These variables are used as proxies of the household normal income ($\bar{Y}$) and income uncertainty ($SDY$), respectively. This allows test the effect that the uncertainty about future income has on household consumption in the year 2014.

From the household average income we construct a control variable capturing if the household income was under a threshold defined as the 20% of the average income of the period in some year.[95] Only the 4.54% of the households had income under the 20% of its average income in some of the previous years and that only the 1.73% of the households the current income, income of 2014, is under the threshold. We include this variable in the consumption regressions in order to check if that has some effect on consumption and if it varies depending on the moment in which that occurs, 2014 or some of the previous years.

The estimated measure of income uncertainty ($SDY$) correlates with some variables commonly related to risk. We include several graphs showing the relationship between the standard deviation of income, $SDY$, and different characteristics of the household reference person commonly related to risk. In this survey the reference person is self-determined and can be defined as the person, or one of the persons, responsible for the accommodation (it will normally be the person in the household who chiefly deals with the financial issues).

[94] To adjust household income to 2014 euros, factors were 1.1001 for 2007, 1.0962 for 2008, 1.0448 for 2010, 1.0205 for 2011 and 0.9896 for 2013 (Banco de España, 2014).
[95] Deidda (2013) stablish this same income threshold but for excluding the households whose earnings were under it.

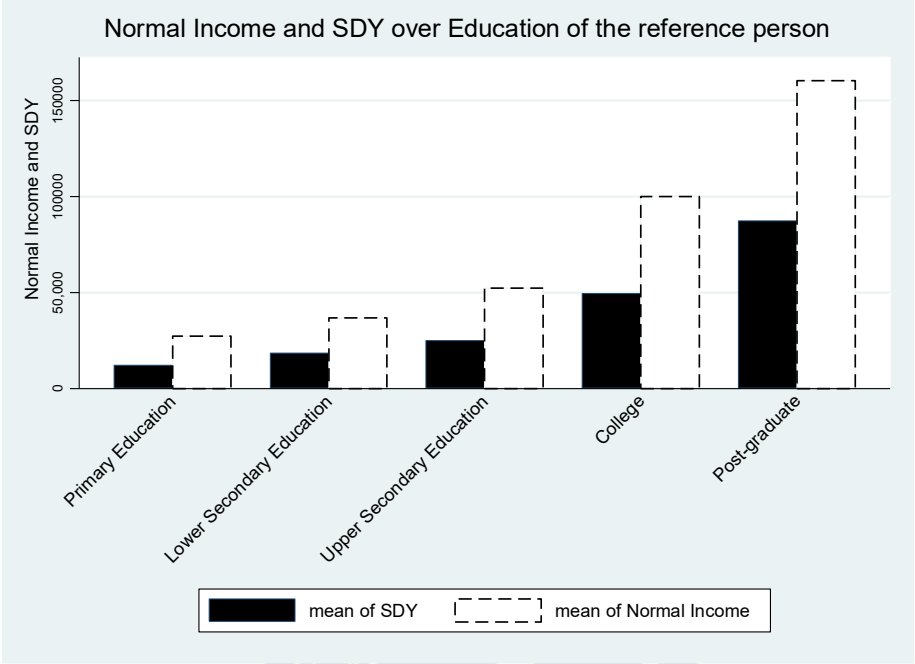
Graph 3.1. Relation between the SDY and the age of the reference person




Own elaboration from the EFF balanced panel data.

The youngest and elderlies exhibit a higher standard deviation of income in relation with the average income, being this more acute for the first (especially for those between 26 and 35 years old). This is consistent with the idea that households with younger heads respond more strongly to the income uncertainty because households with the youngest household heads need to save more in order to build a buffer stock of savings and retired individuals face uncertainty with respect to their survival as well as medical and nursing home expenses which are not present in the middle-aged (Chamon et al., 2013; Kopecky and Koreshkova, 2014).

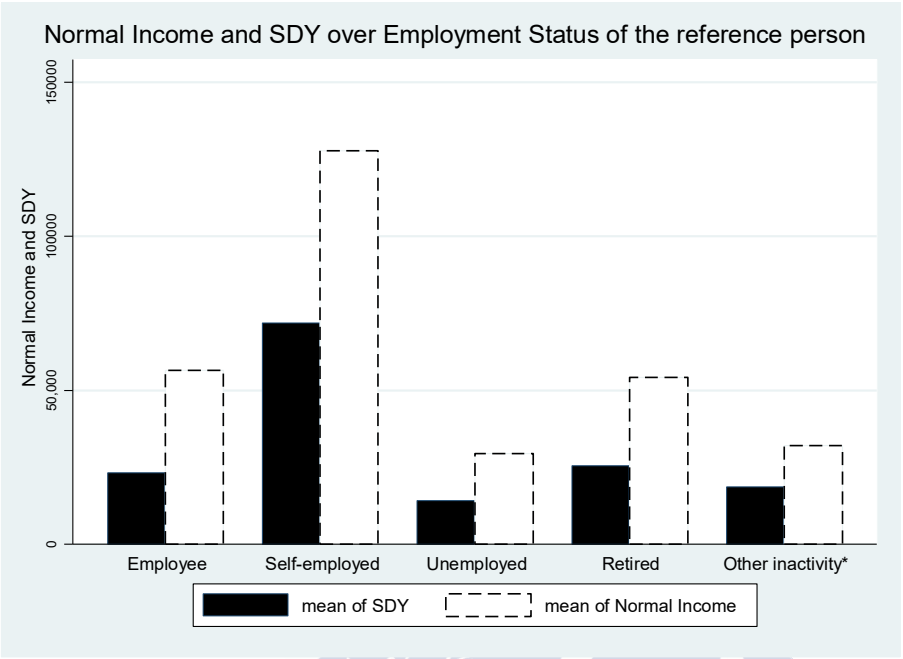
Graph 3.2. Relation between the SDY and the education of the reference person




Own elaboration from the EFF balanced panel data.

Among the different levels of education those with a "post-graduate" have the highest standard deviation of income (being, in average, the 54% of their average normal income) while those with "primary education" have the lowest. Could be that this is related to the labour status or the occupation that individuals are performing in function of their educational attainment

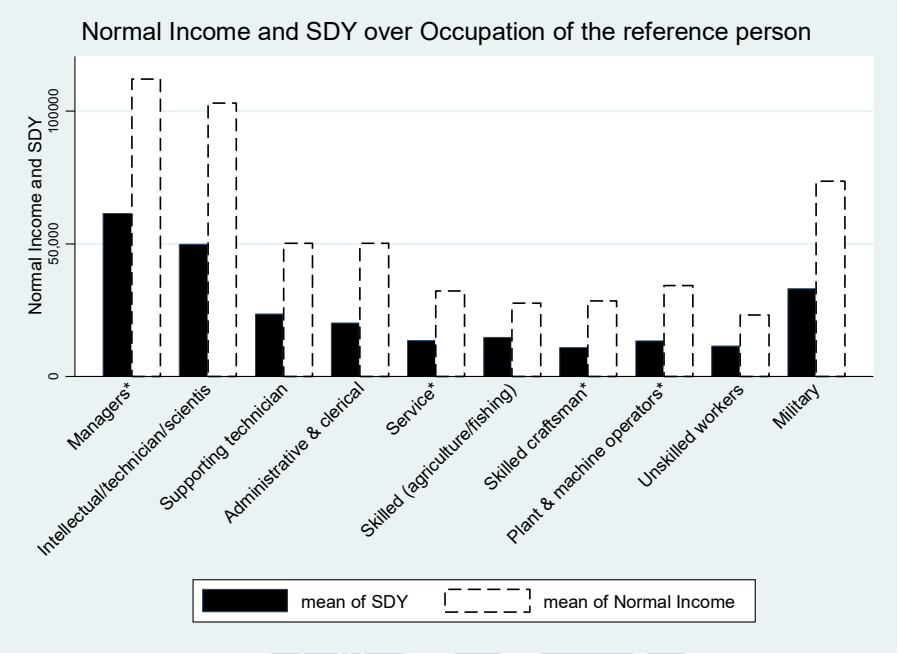
Graph 3.3. Relation between the SDY and the labour status of the reference person




Own elaboration from the EFF balanced panel data. **Notes**: "*other inactivity*" refers to "Permanently disabled or unable to work", or "Student" or "Housewife/house husband".

As expected, those households whose reference person is "self-employed" jointly with those in which is "permanently disabled or unable to work, or student or housewife/house husband" (that is, "other inactive") have the highest uncertainty while the "employees" have the lowest. This is in line with the assumed in the literature: the self-employed have presumably higher income uncertainty (Leland, 1968; Deidda, 2013; Mishra et al., 2013).

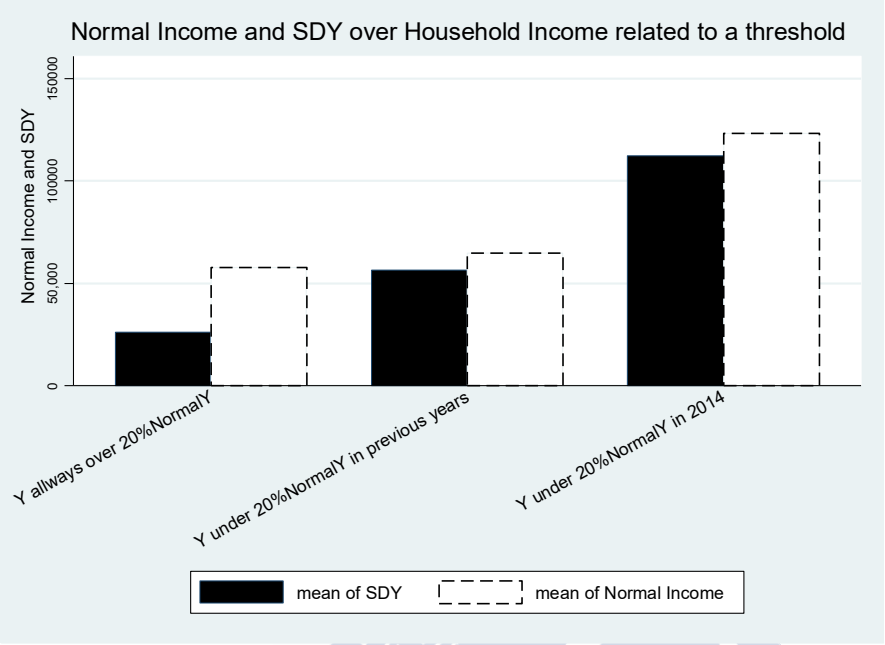
Graph 3.4. Relation between the SDY and the occupation of the reference person*




Own elaboration from the EFF balanced panel data. Notes: Occupation is displayed for those who are working (568). *Managers:* "in the public or private sector". *Service*: "Hotel and catering, personal, security and sales services". *Skilled craftsman* or worker in manufacturing, construction or mining industries. *Plant & machine operators:* "and assemblers"

Among the different occupations, the "managers in the public or private sector", followed by the employed in the category "skilled workers in agriculture and fishing", have the highest income uncertainty respect to their average normal income (the mean of SDY more than the 50% of the mean of normal income). In the considered sample, these occupations are also those with the highest ratio of self-employed and the managers are the most educated people. "Skilled craftsman or worker in manufacturing, construction or mining industries" jointly with "plant and machine operators and assemblers" have the lowest income uncertainty and have also a lower level of education than managers (nobody in these occupations has a post-graduate).

Graph 3.5. Relation between the SDY and the defined threshold for household income




Own elaboration from the EFF balanced panel data.

Respect to the variable capturing whether household income was under the 20% of normal income in some year, the graphs shows that those with income under the defined threshold in 2014 have the highest uncertainty respect to their household normal income while those whose income was always over the threshold have the lowest. That supports the adequacy of our proxy of uncertainty for capturing the uncertainty effect on household consumption.

The graphs show the expected relation between the standard deviation of the income (in relation with the normal income) and the different variables supporting thus the use of this variable as proxy for the income uncertainty borne for the household.

Once showed the validity of the uncertainty proxy estimated, the following section tests the effect that the uncertainty about future income, measured trough the standard deviation of household income,

has on household consumption in the year 2014. In particular, the consumption measure used is the non-durable consumption because it follows a more stable path than the durable consumption so the decrease in consumption when uncertainty arises would reflect the existence of a precautionary motive for saving. That is, since the increase/decrease on total consumption can be for a punctual expenditure in durables goods and not for the effect of the uncertainty, we have decided to analyse how the uncertainty affects the household non-durable consumption.

The consumption variable (the annual household consumption on non-durables in 2014) comprises the following expenditures/payments:

- Annual premium or the one-off premium for the life insurance policies the household has (both the insurance policies taken out by household members on their own decision and those not taken out on their own decision).
- Average annual payment for other forms of insurance (health-care, home and vehicle policies).
- Current monthly payment on the loans on the real estate property, including repayment of capital and interest.
- Current monthly payment on the loan taken out for the purchase of the main residence, including repayment of capital and interest.
- Current monthly payment on other loans that were not mentioned earlier, including repayment of capital and interest.
- Monthly rent paid for the house (give the amount for the most recent payment, and exclude, if possible, communal charges, repairs, water bills, etc.) when the main residence is rented and when a part of the house if owned by the household: monthly rent paid for the part of the house that is not owned by the household.
- Money paid regularly (every month) to other people who are not members of the household, such as ex-partners, children who no longer live at home, parents, charities, etc. (excluding the money paid to household members).

- Household's total average spending on consumer goods in a month, considering all household expenses such as electricity, water, mobile phones, condominium services, leisure, school/university, etc.

Since some variables refer to regular/average monthly expenditure instead annual expenditure we multiply them by twelve to obtain the annual value. The consumption variable used is the sum of all these annual expenditures.

### 3.4. ECONOMETRIC MODEL AND RESULTS

The econometric model relates the consumption of a household with a number of covariates related with the personal, family, work and financial characteristics of the households included in the sample. Specifically, assuming that the relationship among the dependent and independent variables can be expressed in a log-linear form, the models are:

$$logC_{i,t} = \beta_0 + \beta_1 log\bar{Y}_i + \beta_2 logSDY_i + \gamma Z_{i,t} + v_{i,t} \quad (3.1)$$

$$C_{i,t}/\bar{Y}_i = \alpha_0 + \alpha_1 log\bar{Y}_i + \alpha_2 logSDY_i + \theta Z_{i,t} + \varepsilon_{i,t} \quad (3.2)$$

Where $\beta_0$, $\alpha_0$ are the intercept; $\gamma$, $\theta$ are vectors of parameters to be estimated; $Z_{i,t}$ is a vector of variables that reflect the main individual characteristics of each individual/household and the main economic determinants of consumption at time $t$ (income, real and financial wealth, debt, risk aversion, family composition, age and education level of the reference person); $\bar{Y}_i$ is the household average income over the period (2007-2014); $SDY_i$ is the standard deviation of household income (the proxy of uncertainty) and $v_{i,t}$, $\varepsilon_{i,t}$ are the error terms assumed independently and identically distributed as a $N(0, \sigma^2)$. The regressions are estimated for the last year of the survey, 2014, in order to analyse how the average income of the period and the standard deviation of the income affect the household consumption in this year (therefore, $t = 2014$). The economic variables are expressed in logarithms and refer to the whole

household.[96] The age and the educational level are those of the household reference person. The difference between both models is the dependent variable, in (3.1) $logC_{i,t}$ is the logarithm of non-durable consumption of the i-th household in 2014 while in (3.2) $C_{i,t}/\overline{Y}_i$ is the ratio between non-durable consumption of the i-th household in 2014 and the average income of the i-th household for the period 2007-2014. The equations are estimated by OLS.

Therefore, we assess the existence of precautionary saving by analysing the effect of household income uncertainty on consumption. If there is a precautionary saving, uncertainty in the current period (proxied by the standard deviation of income, $SDY_i$) should increase savings and thus decrease current consumption, i.e., we expect a negative sign on this uncertainty variable.

Table 3.1 shows the results of the estimations for 2014. Columns (2) and (4) summarize the estimation of the two consumption models including the uncertainty measure. In particular, column (2) shows the results for the model using the logarithm of non-durable consumption as dependent variable while column (4) summarizes the results for the model using the ratio between non-durable consumption and the average income as dependent variable. Columns (1) and (3) summarize the estimation of both consumption equations without any uncertainty measure to provide a baseline model. In general, the variables included in the estimations are significant (and show the expected signs) and the regressions have a relatively high goodness of fit, with an $R^2$ around 67% in the logarithm of consumption equation and about 39% for the equation of consumption-average income ratio, and the F-statistic suggests that the null hypothesis of jointly insignificance should be rejected.

[96] To avoid outliers we winsorize at the 1% all the economic variables (income, wealth, debt, consumption and, therefore, the average income and the standard deviation of it). We also do a change of scale when calculating the logarithm of these variables to avoid lose observations when the value of the variable is 0 (about the half of the households have zero value for the debt); specifically, we do the logarithm of the variable plus one (i.e., ln(*variable*+1)).

Table 3.1. The uncertainty effect on household non-durable consumption in 2014

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | $ln(Cons)$ | $ln(Cons)$ | $Cons\ /\bar{Y}$ | $Cons\ /\bar{Y}$ |
| Ln($\bar{Y}$) | 0.436*** | 0.528*** | -0.243*** | -0.217*** |
| | (0.020) | (0.029) | (0.013) | (0.019) |
| **Ln(SDY)** | | **-0.068*** ** | | **-0.019** ** |
| | | (0.016) | | (0.009) |
| Ln(FW) | 0.019*** | 0.017*** | 0.007* | 0.007 |
| | (0.005) | (0.005) | (0.004) | (0.004) |
| Ln(RW) | 0.004 | 0.004 | 0.000 | 0.000 |
| | (0.004) | (0.004) | (0.003) | (0.003) |
| Ln(debt) | 0.028*** | 0.027*** | 0.013*** | 0.013*** |
| | (0.002) | (0.002) | (0.001) | (0.001) |
| Credit constraints | 0.001 | 0.008 | 0.030 | 0.032 |
| | (0.038) | (0.038) | (0.028) | (0.028) |
| Risk aversion | -0.091*** | -0.093*** | -0.051*** | -0.052*** |
| | (0.031) | (0.031) | (0.016) | (0.016) |
| Family size | 0.096*** | 0.090*** | 0.034*** | 0.033*** |
| | (0.013) | (0.013) | (0.007) | (0.007) |
| Number of children | -0.005 | -0.000 | 0.006 | 0.007 |
| | (0.020) | (0.020) | (0.011) | (0.011) |
| Age | 0.008*** | 0.007*** | 0.004*** | 0.004*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Primary education | -0.081** | -0.077** | -0.037* | -0.035* |
| | (0.032) | (0.031) | (0.020) | (0.020) |
| Upper secondary education | 0.004 | -0.001 | -0.012 | -0.014 |
| | (0.034) | (0.034) | (0.020) | (0.020) |
| College | 0.105*** | 0.095** | 0.044** | 0.041* |
| | (0.038) | (0.038) | (0.022) | (0.022) |
| 1. $Y_t$<0.2$\bar{Y}$ in at least one year before 2014 | 0.116** | 0.173*** | 0.086** | 0.102*** |
| | (0.050) | (0.052) | (0.038) | (0.039) |
| 2. $Y_t$<0.2$\bar{Y}$ in 2014 | -0.130 | -0.074 | -0.047 | -0.032 |
| | (0.087) | (0.088) | (0.037) | (0.038) |
| _cons | 4.163*** | 3.893*** | 2.675*** | 2.599*** |
| | (0.190) | (0.199) | (0.103) | (0.115) |
| r2_a | 0.6671 | 0.6706 | 0.3913 | 0.3926 |
| N | 1524 | 1524 | 1524 | 1524 |

*Notes:* Coefficient estimates. Cluster robust standard errors in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.10.

In general, the results for the standard control variables are in line with previous analysis, with expected signs. Wealth impacts positively on consumption, but real wealth is not significant in both models. An explanation to this result can be that the value of the real estate assets of households, which represents a substantial part of their total assets, fell dramatically as a result of the burst of the housing bubble and continued to experience significant reductions as a result of the continued fall in the price of housing. This decrease was only interrupted from the second quarter of 2014, with an increase of 0.3% in the annual average, after six years of decline. The evolution of real estate prices from its maximum level in the third quarter of 2007 has represented a loss of value of this asset of 37.2% in nominal terms (44.3% in real terms) up to the first quarter of 2014. Turning to the financial wealth, during the considered period households tended to accumulate financial assets. According to the Bank of Spain, compared to the first quarter of 2009, in 2014 the percentage of Spanish households with some financial asset was greater although the decrease in this percentage from 2011 (the increase in this percentage between 2009 and 2011 was higher in the lower half of the wealth distribution but also its decrease between 2011 and 2014 was greater for this group). For families with some kind of financial asset, the median value of these assets increased by 23.1% between 2009 and 2011 but decreased by 5.1% between 2011 and 2014.[97]

Income is significant in both specifications and the elasticity of income remains more or less stable between the baseline specification of the model and the specification with uncertainty which means that the estimated parameter is robust to the type of specification. But the sign of the variable change with the dependent variable: in the model with the logarithm of consumption as dependent variable, the income has a positive effect on consumption while in the model of the ratio between consumption and average income the impact is negative. It shows that as income increases, the propensity to save increases (or MPC declines). Since the magnitude of the coefficients in the model for the logarithm of consumption are lower than 1, therefore, as

[97] See Banco de España (2014, 2017).

income increase, consumption goes one, but the elasticity is less than one.

The dummy variable reflecting whether the household is risk averse has a negative and significant coefficient in both models. However, the dummy collecting the existence of credit constraints in the households is not significant in any of the specifications. The relation between the level of indebtedness and household consumption is positive, reflecting that those with higher debt are also those with a higher consumption. Debt is for the most part mortgages and people with mortgages are richer than people without.[98]

Households whose income was under the threshold (defined as the 20% of the average income of the period) in some year before 2014 have a higher consumption in this last year (with significant coefficients), while those whose income is under the threshold in 2014 reduce their consumption but in this case the coefficients are not significant in any model. Household characteristics show the expected relations. Additionally, the estimated coefficients are, in general, robust to the specification as regards the inclusion of the uncertainty measure, even though they differ in magnitude between the two consumption models considered in our analysis.

In relation with the uncertainty measure, the standard deviation of household income shows a negative and significant coefficient in both models. So, an increase in the income uncertainty borne by the households reduces its current consumption, implying (given the level of household income) certain amount of precautionary savings. This result is in line with those of Albarrán (2000), Barceló and Villanueva (2016), Campos and Reggio (2015) (or also the found in chapter 2) who also show evidence of precautionary saving in Spain in different periods of time and using different data sources. The main difference with these works is that we use an uncertainty measure derived from

[98] The correlation between total debt and 'debt of other real estate properties different of main residence' is the highest (0.9411) among all the debt components. Only the 12.44% of the households have this type of debt which is mainly destined to the purchase of another house or flat (79.7% of those with a second property) and people with this mortgage are also the richest (their gross wealth is 2.17 times the wealth of those who haven't a second property).

observed household income from panel data and most of the evidence about precautionary saving for Spain estimate unemployment risk or use rotating panel data. The effect the income uncertainty has on consumption is softer when we have into account the level of income than in absolute terms. The uncertainty measure has a larger impact on the logarithm of consumption (-0.068) than in the ratio consumption – normal income (-0.019). This reduction of 0.019 in the ratio $Cons\ /\bar{Y}$ when the $SDY$ increases by 1% implies, given the average consumption and normal income in the sample, that consumption will decrease by 5.03% while in the model for the $ln(Cons)$, an increase of 1% in the $SDY$ will decrease consumption by 6.8%.

The evidence obtained in this analysis for the Spanish households is consistent with the hypothesis that households adjust their consumption and savings to changes in the risk of income. Therefore, our results show evidence of the existence of precautionary savings in Spanish households in 2014.

### 3.5. CONCLUDING REMARKS

Earnings uncertainty is the source of uncertainty most frequently studied in the theoretical literature about precautionary savings and the income variability is the most common uncertainty proxy used in empirical works. The analysis performed in this chapter contributes to the existing literature testing the effect the income uncertainty has on consumption of Spanish households. The main contribution of this work is to provide evidence about precautionary saving in Spain measuring income uncertainty from the panel component of the EFF. We derive a measure of income risk using the individual observed data on income for a period comprising 8 years. From that we calculate the standard deviation of household real income as proxy of the income uncertainty borne by the household and test the effect it has on household consumption in 2014.

According to our estimations, an increase of 1% in the standard deviation of household income decreases household consumption between 5% and 7% implying (given the level of household income) certain amount of precautionary saving.

An increase in the income uncertainty borne by the Spanish households reduces its current consumption, so that we can conclude about the evidence of the existence of precautionary saving in Spain. This evidence for the Spanish households is consistent with the hypothesis that households adjust their consumption and savings to changes in the risk of income.

# GENERAL CONCLUSIONS

The main objective of this thesis was analyse the uncertainty effect on consumption and saving decisions, that is, the existence of precautionary saving in Spain. The general conclusion is that in general uncertainty affects consumption and saving decisions (what has been shown in many papers for different countries) and also in the particular case of Spain (as the results reached in the second and third chapter of this document conclude). But as shown in the literature review chapter and as we have tested in our empirical analysis, not all the measures which can be used to proxy the uncertainty are adequate for all the countries or in all the macroeconomic contexts.

The review of the empirical literature provided in the **first chapter** shows that empirical papers analysing a precautionary motive for saving led to different results and conclusions. The main conclusion that can be drawn is that there is neither consensus on the strength of that motive for saving, nor on the most appropriate measure of uncertainty (taking subjective or objective measures) nor about the particular uncertainty proxy. Empirical results don't change with the chosen dependent variable but with the economy in which precautionary saving is analysed, the considered uncertainty measure or the econometric model. The use of macro data for the estimation of saving equations (Hahm, 1999; Hahm and Steigerwald, 1999; Menegatti, 2010; Mody et al., 2012; Baiardi et al., 2013; or Bande and Riveiro, 2013) seems to validate the precautionary saving hypothesis. But, given that consumption (and saving) decisions are taken by individuals, the best option to obtain a good indicator of uncertainty should be the use of micro data, which allow to measure the specific risk of individuals or households (Guiso et al., 1992, 1996; Dynan, 1993; Lusardi, 1997, 1998; Carroll, 1994; Carroll and Samwick, 1997; Kazarosian, 1997; Miles, 1997; Banks et al., 2001; Guariglia, 2001; Guariglia and Kim, 2003; Benito, 2006; or Deidda, 2013). In recent years it has become apparent the necessity to control for

environmental conditions or health status in order to obtain a good estimate of precautionary saving, since individuals bear not only financial/economic risks but also another background risks which affect the consumption/saving decisions under uncertainty (see Baiardi et al. 2016).

In sum, although most of the reviewed works find evidence of precautionary motive for saving there is not a consensus on the magnitude of this effect (some works conclude that this motive is nearly irrelevant), nor on the most adequate proxy for the uncertainty.

In general, the evidence found in the **second chapter** supports the existence of a precautionary saving motive among the Spanish households, and adds to the existing literature on this topic by providing new estimates based on different uncertainty sources. The magnitude of the effect that uncertainty has on household consumption varies depending on the considered measure of uncertainty, and the most adequate measure in each case varies with the macroeconomic context.

The findings suggest that subjective uncertainty measures do not provide any supportive evidence of a precautionary saving motive. Among the objective measures included in the econometric models, it seems that the job insecurity indicator serves as an adequate uncertainty measure, while the unemployment rate provides mixed results, dependent on the time period or the econometric specification. We interpret this result as the outcome of the combination of a high and persistent jobless rate (which has never fell below 7%, even in the best years of the previous expansionary business cycle), an extremely persistent distribution of personal characteristics within our sample, especially as regards unemployment risk, and an imperfect unemployment risk assignment in our empirical model, since we are using 5-year average unemployment rates. The job insecurity indicator, in addition of being an individual measure not affected by assignment biases, measures more dimensions than just unemployment risk, which may exert a significant effect on consumption and saving decisions: type of contract, size of the firm, unemployment record, etc. The empirical results provided in this

second chapter suggest that this is the case, the job insecurity indicator has a clear negative effect on consumption decision, regardless of the econometric specification.

**The third chapter** reinforces the results shown on chapter two providing evidence about the effect of the income uncertainty (proxied trough the variability of household income) on Spanish household consumption. Earnings uncertainty is the source of uncertainty most frequently studied in the theoretical literature about precautionary savings and the income variability is the most common uncertainty proxy used in empirical works.

The main contribution of this chapter is to provide evidence about precautionary saving in Spain measuring income uncertainty through the income variability calculated from the panel component of the EFF. Using the individual observed data on income for a period comprising 8 years a measure of household normal income is derived. From that the standard deviation of household income is calculated and used as proxy of the income uncertainty borne by the household in order to test the effect it has on household consumption in 2014. According to the estimations, an increase of 1% in the standard deviation of household income decreases household consumption between 5% and 7% implying (given the level of household income) certain amount of precautionary saving.

The chapter concludes about the evidence of the existence of precautionary saving in Spain since an increase in the income uncertainty borne by the Spanish households reduces its current consumption. This evidence for the Spanish households is consistent with the hypothesis that households adjust their consumption and savings to changes in the uncertainty of income.

The results achieved in this research work may be helpful for **the design of economic policy**. On the one hand, they suggest that labour market reforms that tend to weaken the position of workers as regards job security are likely to impact negatively on aggregate demand, through falls in consumption. This is especially relevant in a highly indebted economy, as the Spanish one, where additional savings could be used to cancel out debts instead of being directed towards

investment. On the other hand, it may also be concluded that keeping a low and stable unemployment rate in the economy is not only an economic target *per se*, but would help in reducing the volatility of the saving rate of households.

***Further research.*** Since the 2011 and 2014 waves of the EFF are integrated into the Eurosystem Household Finance and Consumption Survey (EHFCS) of the European Central Bank, homogeneous comparisons among different European countries are possible.

So, we can make a robustness analysis to the obtained results by comparing the Spanish case with that of our neighbour countries using the EHFCS data set. In particular, two different analysis are proposed. On the one hand, we can construct a homogeneous job insecurity indicator for different European countries (in line with that we have constructed) in order to test whether this indicator is also a good proxy of the uncertainty in other economies than the Spanish one.

On the other hand, it would also be interesting to take into account some background risk, as the health risk, in the analysis performed for Spain to check the consumption behaviour under the presence of two simultaneous risks. This could be extended to the remaining European countries included in the EHFCS, trying to test the significance of this background risk in the different countries and whether the differences in the health care systems modify the effect this type of uncertainty has on consumption/saving decisions of European households

# RESUMEN

Una de las principales consecuencias de la crisis económica y financiera de los últimos años fue el incremento en los niveles de incertidumbre macroeconómica (reflejada, por ejemplo, en la volatilidad y la variabilidad de las proyecciones macroeconómicas hechas por las principales instituciones internacionales: OCDE, Comisión Europea, FMI, etc.) que, a su vez, causaron volatilidad en las decisiones microeconómicas de los agentes privados, principalmente en las relacionadas con el consumo y la inversión. El ahorro por motivo precaución surge en contextos de incertidumbre y es por ello que este tema ha cobrado especial relevancia en los últimos años en los que la agitación financiera, económica y política provocaron un aumento de la incertidumbre sobre la renta futura afectando, por lo tanto, a las decisiones de los hogares sobre consumo y ahorro.

En el caso de la economía española, las fuertes caídas en el consumo de los hogares que recogen las Cuentas Nacionales están relacionadas con las caídas en el nivel de renta disponible, pero también pueden tener un cierto componente de ahorro precaución. De hecho, la tasa de ahorro de la economía española, que había alcanzado mínimos históricos durante la última expansión, comenzó a aumentar notablemente en las primeras fases de la recesión. Este aumento puede ser interpretado como una forma de protección contra la creciente incertidumbre generada por una recesión generalizada acompañada de tasas de desempleo cada vez más altas. Además, en las fases más recientes de la recesión, el aumento en la tasa de ahorro se estanca e incluso revierte, mientras que el consumo continúa cayendo en picado. Por lo tanto, la reciente experiencia de la economía española hace relevante un análisis detallado de los patrones de consumo de los hogares desde el comienzo de la recesión, así como el efecto que la incertidumbre, medida desde diferentes perspectivas, tiene sobre ellos. La necesidad de desarrollar este estudio se ve reforzada por el hecho

de que el tipo de incertidumbre que afecta a las decisiones de consumo afecta al diseño de la política macroeconómica.

El objetivo principal de esta tesis es analizar el efecto de la incertidumbre sobre las decisiones de consumo y ahorro de los hogares españoles, a través de un análisis empírico con datos microeconómicos, y contrastar de ese modo la hipótesis del ahorro por motivo precaución en España.

Con ese propósito, el primer objetivo es proporcionar una revisión exhaustiva de la literatura sobre ahorro precaución, que aborde las principales cuestiones controvertidas y los diferentes enfoques seguidos por los estudios que tratan empíricamente el análisis de la existencia de ahorro precaución, con el fin de establecer el marco para los análisis empíricos posteriores. Estos análisis empíricos permitirán, en primer lugar, arrojar luz sobre la existencia de un motivo precaución para explicar el ahorro en España, ya que la literatura existente no es concluyente ni sobre la existencia del mismo ni sobre su magnitud. En segundo lugar, identificar el impacto de diferentes fuentes de incertidumbre sobre las decisiones de consumo/ahorro a nivel microeconómico, de modo que se proporcione evidencia a favor de algunas de las medidas de incertidumbre alternativas discutidas previamente.

La principal contribución de la tesis es, por tanto, proporcionar evidencia sobre ahorro precaución en España, así como una revisión exhaustiva de la literatura empírica sobre este tema. Dado que nuestros resultados econométricos muestran un impacto negativo de la incertidumbre en el consumo de los hogares, podemos concluir que hay evidencia de la existencia de ahorro precaución en España. Esta es una contribución importante porque, aunque la mayoría de los trabajos empíricos encuentran evidencia de un efecto de la incertidumbre sobre el ahorro, no en muchos países hay evidencia sobre este motivo para el ahorro (EE. UU., Italia, Reino Unido, Alemania y algunos otros). En el caso de España, la evidencia sobre ahorro precaución es escasa.

El primer capítulo de este trabajo proporciona una revisión de la evidencia que se encuentra en la literatura sobre ahorro precaución, así como de los diferentes enfoques econométricos y proxies de

incertidumbre que se utilizan habitualmente. En el marco del modelo de Ciclo de Vida/Renta Permanente, un nivel positivo de ahorro es consecuencia de un futuro descenso en el patrón de ingresos racionalmente esperado por los consumidores. En este contexto, el ahorro es la forma de asignar de manera óptima los ingresos de toda la vida al consumo de toda la vida. Pero, cuando las decisiones de consumo se toman en un contexto de incertidumbre, y los individuos son prudentes y buscan protección contra el riesgo, hay un impacto negativo significativo de la incertidumbre en el consumo actual. Es decir, la incertidumbre genera un ahorro adicional positivo, el llamado "ahorro precaución". Esencialmente, el ahorro precaución es un fenómeno relacionado con la incertidumbre sobre la renta futura y, por lo tanto, con las posibilidades de consumo futuras, siempre que la utilidad marginal del consumo sea convexa ($u'''(\cdot) > 0$). Un aumento en la incertidumbre sobre la renta futura reducirá el consumo actual modificando la pendiente del patrón de consumo. De este modo, los supuestos sobre los procesos estocásticos de la renta y las tasas de rendimiento, así como la especificación de las funciones de utilidad, determinarán el patrón de consumo. Por lo tanto, el tipo de aversión al riesgo inherente a las preferencias es relevante para comprender el impacto de la incertidumbre sobre la renta futura en las decisiones de ahorro.

Dadas las condiciones formales estándar bajo las cuales existe un motivo precaución para el ahorro, su relevancia es un tema abordado principalmente de manera empírica. Dependiendo de la disponibilidad de los datos y del tipo de análisis, esta teoría ha sido probada tanto a nivel macroeconómico como a nivel microeconómico, utilizando ecuaciones de riqueza, consumo o ahorro y tomando datos de panel, datos transversales o datos de series temporales. A pesar de la existencia de un gran número de estudios, los resultados empíricos son mixtos. La mayoría de los trabajos encuentran evidencia de un efecto de la incertidumbre sobre el ahorro, pero no hay consenso ni sobre la intensidad de este motivo para ahorrar, ni sobre cuál es la medida más apropiada para aproximar la incertidumbre. Este último problema es en realidad el mayor de los problemas a la hora de analizar el efecto de la incertidumbre sobre las decisiones de consumo y ahorro. Hay un

gran número de posibles medidas de incertidumbre y determinar cuál es la óptima es una tarea difícil. Además de encontrar una "buena" medida a nivel teórico, debemos añadir las dificultades relacionadas con la disponibilidad de datos o la adecuación de los mismos al análisis. Todas estas dimensiones (tipo de enfoque empírico, tipo de datos, medida de incertidumbre, etc.) se tienen en cuenta al resumir las principales contribuciones de la literatura empírica sobre el ahorro precaución.

Además de la relevancia del motivo precaución para determinar el ahorro, se debe enfatizar que este motivo proporciona también un fundamento para los llamados "puzles empíricos del consumo". Numerosos estudios concluyen que la hipótesis de la renta permanente (PIH) fracasa al explicar la dinámica del consumo por "exceso de sensibilidad" (Flavin, 1981) y por "exceso de suavidad" (Deaton, 1987). Además, la PIH no puede explicar el "exceso de crecimiento" del consumo (Deaton, 1987). A pesar de que se han planteado numerosos argumentos para explicar estos tres enigmas (como las consideraciones de equilibrio general, la miopía del consumidor, la existencia de restricciones de liquidez, etc.), ninguno parece ofrecer tantas respuestas simultáneas como la existencia de un motivo precaución para el ahorro.

El primer capítulo muestra que los resultados y las conclusiones alcanzadas en los trabajos empíricos que analizan el ahorro precaución son mixtos. La principal conclusión que se puede extraer es que no hay consenso sobre la intensidad de este motivo para ahorrar, ni sobre la medida de incertidumbre más adecuada (si deben considerarse medidas subjetivas u objetivas ni, por tanto, sobre la proxy de incertidumbre específica). Los resultados empíricos no cambian con la variable dependiente elegida, sino con la economía en la que se analiza el ahorro precaución, la medida de incertidumbre considerada o el modelo econométrico especificado. El uso de macro datos para la estimación de ecuaciones de ahorro (Hahm, 1999; Hahm y Steigerwald, 1999; Menegatti, 2010; Mody et al., 2012; Baiardi et al., 2013; o Bande y Riveiro, 2013) parece validar la hipótesis de ahorro precaución. Pero, dado que las decisiones de consumo (y ahorro) son tomadas a nivel individual, la mejor opción para obtener un buen

indicador de incertidumbre debería ser el uso de micro datos, que permiten medir el riesgo específico de los individuos u hogares (Guiso et al., 1992, 1996; Dynan, 1993; Lusardi, 1997, 1998; Carroll, 1994; Carroll and Samwick, 1997; Kazarosian, 1997; Miles, 1997; Banks et al., 2001; Guariglia, 2001; Guariglia and Kim, 2003; Benito, 2006; o Deidda, 2013). En los últimos años se ha puesto de manifiesto la necesidad de controlar las condiciones ambientales o el estado de salud para obtener una buena estimación del ahorro precaución, ya que los individuos soportan no solo riesgos financieros/económicos sino también otros riesgos que afectan las decisiones de consumo/ahorro en un contexto de incertidumbre (ver Baiardi et al., 2016).

El segundo capítulo evalúa la hipótesis del ahorro precaución para una muestra de hogares españoles, utilizando diferentes medidas de incertidumbre subjetivas y objetivas. Éstas se construyen a partir de los datos de corte transversal de la Encuesta Financiera de las Familias (EFF) y, por ello, el capítulo incluye una descripción detallada de los datos de la encuesta y su metodología.

Esta base de datos tiene características muy interesantes en relación con el análisis que se propone, ya que permite analizar el comportamiento del consumo/ahorro de las familias españolas desde diferentes perspectivas (niveles de endeudamiento, grado de precariedad en el mercado laboral, posesión de activos reales o financieros, etc.), todas ellas relevantes para la cuantificación de la incertidumbre y, por lo tanto, para la explicación de los patrones de consumo. La EFF es una encuesta oficial realizada por el Banco de España desde el año 2002 (cada tres años) para obtener información directa sobre las condiciones financieras de las familias españolas. La encuesta proporciona información sobre diferentes aspectos de la situación económica y financiera de los hogares españoles antes y durante la crisis actual y, por lo tanto, permite analizar los patrones de consumo/ahorro de los hogares españoles. Es la única fuente estadística en España que permite la vinculación de ingresos, activos, deudas y gastos de cada hogar. Todas las oleadas de la EFF tienen dos objetivos, el primero es lograr una muestra representativa de la población actual con un sobre-muestreo de los hogares ricos y el segundo es convertir parte de esta muestra en un panel al volver a

entrevistar a los hogares que participaron en oleadas anteriores. Por tanto, las principales características de esta encuesta son que incluye un sobre-muestreo de los hogares ricos y un componente de panel. Otra característica importante de esta encuesta es el uso de la técnica de imputación múltiple para imputar los valores perdidos inherentes a las encuestas de ingresos/riqueza, de modo que el usuario debe lidiar con estos datos de imputación múltiple a la hora de realizar cualquier análisis empírico con estos datos.

La característica principal de este capítulo es la inclusión de múltiples medidas de incertidumbre. En la literatura existente, cada autor ha construido diferentes medidas basadas en la información específica proporcionada por el conjunto de datos que emplea. En este sentido, este trabajo revisa esas medidas e incluye tantas como es posible (dados los datos de que disponemos) en la especificación de una función de consumo empírico. Esto permite verificar cuáles de esas medidas son más fiables como fuentes de incertidumbre para los hogares incluidos en nuestra muestra. Además, se construye un índice compuesto individual de inseguridad laboral, basado en la información proporcionada por el conjunto de datos, que permite introducir una nueva fuente de incertidumbre de renta: la inseguridad laboral a la que se enfrenta la persona de referencia del hogar. Este índice compuesto individual combina información sobre antigüedad, tipo de dedicación (tiempo parcial/tiempo completo), tipo de contrato, número de empleadores anteriores, tamaño de la empresa y si estuvo desempleado durante el año anterior. Cuanto más alto es el índice, más vulnerable es el trabajador a una posible pérdida del empleo, de modo que esperaríamos una caída en el consumo actual (para aumentar el ahorro como un amortiguador frente a las posibles contingencias futuras). Hasta donde sabemos, esta es la primera vez que se introduce un índice compuesto de este tipo en una ecuación de consumo para contrastar la hipótesis de ahorro precaución.

Otra característica de este capítulo es que incluye datos para dos años (2008 y 2011) que permiten comparaciones entre el comportamiento del consumo de los hogares antes y durante la Gran Recesión. Es probable que la magnitud de dicha recesión, especialmente en el caso español, haya modificado los patrones de

consumo y ahorro subyacentes. Los resultados sugieren que, de hecho, este es el caso y que las fuentes de incertidumbre que tienen un impacto sobre las decisiones de los hogares son diferentes en los distintos momentos del tiempo.

Este capítulo contribuye a la literatura existente en tres aspectos principales. En primer lugar, utilizando una muestra de hogares españoles se proporciona nueva evidencia a favor de la existencia de un motivo precaución para el ahorro. Los resultados econométricos confirman inequívocamente la existencia de un impacto negativo de la incertidumbre en el consumo. En segundo lugar, se muestra que dependiendo de la medida de incertidumbre específica, su impacto en el consumo es diferente. En general, las medidas subjetivas (basadas en la autopercepción sobre la variabilidad futura de la renta del hogar) tienden a generar un impacto no significativo en el consumo y, por lo tanto, en el ahorro. Las medidas objetivas (como el riesgo de perder el trabajo, representado por la tasa de desempleo o la inseguridad laboral que afectan a la persona de referencia del hogar) generan un impacto negativo significativo en el consumo. Finalmente, se muestra que el impacto de estas medidas objetivas es diferente según el momento del ciclo económico estudiado. En concreto, en un contexto de bajas tasas de desempleo, la incertidumbre medida a través de la tasa de desempleo no tiene impacto en el consumo del hogar, mientras que cuando esta tasa es alta y creciente, se convierte en una importante fuente de incertidumbre de renta, generando una gran parte del ahorro precaución. Sin embargo, cuando se controla por efectos invariantes en el tiempo al estimar un modelo de datos de panel con efectos fijos, contrariamente a lo esperado, la tasa de desempleo tiene un efecto significativo y positivo sobre el consumo, lo que arroja dudas sobre la validez de esta variable como una medida de incertidumbre adecuada. Este resultado puede interpretarse como el resultado de la combinación de una tasa de desempleo alta y persistente (que nunca ha caído por debajo del 7%, incluso en los mejores años del ciclo económico expansivo anterior), una distribución extremadamente persistente de las características personales dentro de nuestra muestra, especialmente en lo que respecta al riesgo de desempleo, y una asignación imperfecta de riesgo de desempleo en nuestro modelo

empírico, ya que se utilizan tasas de desempleo promedio por grupos quinquenales de edad. La medida de inseguridad laboral, por el contrario, es significativa en todos los horizontes del ciclo económico, así como en la especificación de panel. Este indicador, además de ser una medida individual no afectada por sesgos de asignación, mide más dimensiones que el riesgo de desempleo (tipo de contrato, antigüedad, si estuvo desempleado o no durante el año anterior, etc.) lo que tiene un efecto significativo en las decisiones de consumo y ahorro.

En general, la evidencia encontrada en el segundo capítulo apoya la existencia de un ahorro precaución entre los hogares españoles, y se suma a la literatura existente sobre este tema al proporcionar nuevas estimaciones basadas en diferentes fuentes de incertidumbre. La magnitud del efecto que tiene la incertidumbre en el consumo de los hogares varía según la medida de incertidumbre considerada, y la medida más adecuada en cada caso varía con el contexto macroeconómico.

El tercer capítulo analiza también la existencia de ahorro precaución en España a través del efecto que la incertidumbre de renta, calculada a partir del componente de panel de la EFF, tiene sobre el consumo de los hogares. En este capítulo se utilizan datos objetivos de la encuesta para estimar la incertidumbre de renta de modo que el análisis se enmarca en los trabajos empíricos que miden la incertidumbre de renta a través de la variabilidad de la renta observada durante un periodo de tiempo (Kazarosian, 1997; Carroll y Samwick, 1998; Guariglia, 2001; Ventura y Eisenhauer, 2006).

La incertidumbre sobre la renta es la fuente de incertidumbre estudiada con más frecuencia en la literatura teórica sobre el ahorro precaución y la variabilidad de la renta es la proxy de incertidumbre más comúnmente utilizada en los trabajos empíricos. La principal contribución de este capítulo es proporcionar evidencia sobre el ahorro precaución en España aproximando la incertidumbre a través de la variabilidad de la renta del hogar. Esta proxy de incertidumbre se calcula, utilizando el componente de panel de la encuesta, a partir de los datos individuales de la renta observada del hogar durante un

período de 8 años y se utiliza luego para analizar el efecto que tiene sobre su consumo en el año 2014.

El análisis se realiza en dos pasos. En una primera etapa, se estima la medida de incertidumbre de renta basada en los datos de panel desde el año 2007 al 2014. En particular, se calcula la renta real media del hogar durante el período y su desviación estándar (para cada hogar) como proxies de la renta permanente y la incertidumbre de renta del hogar, respectivamente. En relación con esto, se muestra que esta medida de incertidumbre correlaciona con algunas variables que habitualmente se consideran relacionadas con la incertidumbre, como el trabajo por cuenta propia, la edad, etc. En un segundo paso, se relaciona la variable de la incertidumbre de renta con el consumo, testando de ese modo si la incertidumbre afecta al consumo de los hogares en 2014, el último año disponible de la encuesta.

Hasta donde sabemos, es la primera vez que se proporciona evidencia sobre el ahorro precaución en España midiendo la incertidumbre de renta a partir de datos observados de la renta real de los hogares durante un período de tiempo. Los resultados muestran que el aumento de la incertidumbre tiene un impacto negativo sobre el consumo de los hogares cuya magnitud difiere ligeramente con la variable de consumo utilizada como variable dependiente en el modelo. En la ecuación estimada para el logaritmo del consumo del hogar, un aumento del 1% en la incertidumbre de la renta causará una caída del consumo de, aproximadamente, un 7%, sin embargo, en la ecuación estimada para la ratio entre consumo y renta permanente, el efecto es menor, dada la renta normal promedio y el consumo de la muestra, el consumo disminuirá en un 5%.

Este tercer capítulo refuerza los resultados obtenidos en el segundo capítulo al concluir que un aumento en la incertidumbre de renta que soportan los hogares españoles reduce su consumo actual, corroborando la evidencia de la existencia de ahorro precaución en España. Según las estimaciones, un aumento del 1% en la desviación estándar de la renta del hogar disminuye el consumo de los hogares entre un 5% y un 7%, lo que implica (dado el nivel de renta del hogar) cierta cantidad de ahorro precaución. Esta evidencia para los hogares

españoles es consistente con la hipótesis de que los hogares ajustan su consumo y ahorro ante cambios en la incertidumbre de renta.

Como se mencionó al inicio de este resumen, el objetivo principal de esta tesis es analizar el efecto de la incertidumbre sobre las decisiones de consumo y ahorro, es decir, la existencia de ahorro precaución, en España. Los análisis realizados concluyen que la incertidumbre afecta a las decisiones de consumo y ahorro en general (como ha sido demostrado en muchos artículos para diferentes países) y también en el caso particular de España (como se muestra en los resultados obtenidos en el segundo y tercer capítulo de este trabajo). Pero al igual que se muestra en el capítulo de revisión de la literatura y como se ha demostrado en el análisis empírico realizado en este trabajo, no todas las medidas que pueden usarse para representar la incertidumbre son adecuadas para todos los países o en todos los contextos macroeconómicos.

Los resultados obtenidos en este trabajo pueden ser útiles para el diseño de la política económica. Por un lado, sugieren que las reformas del mercado laboral que tienden a debilitar la posición de los trabajadores en lo que respecta a la seguridad laboral probablemente impactan negativamente en la demanda agregada, a través de caídas en el consumo. Esto es especialmente relevante en una economía muy endeudada, como la española, donde los ahorros adicionales podrían usarse para cancelar las deudas en lugar de destinarse a la inversión. Por otro lado, se puede concluir que mantener una tasa de desempleo baja y estable en la economía no es solo un objetivo económico *per se*, sino que ayudaría a reducir la volatilidad de la tasa de ahorro de los hogares.

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# APPENDIX

## Appendix A. Chapter 2

Table A1. List of variables used in the model and their description

| Variable | Variable Notation | Brief description |
|---|---|---|
| Consumption | ln(C) | Average annual non-durable consumption of the household, in logarithms |
| Income | ln(Y) | Total annual income of the reference person in the previous year, in logarithms |
| Real wealth | ln(RW) | Household real wealth, in logarithms |
| Financial wealth | ln(FW) | Household financial wealth, in logarithms |
| Debt | Debt/HY | Household debt by categories according with the ratio debt/gross household income. Three categories: * |
| | Debt/HY=0 | The ratio debt-household income is zero (debt value=0) |
| | 0 < Debt/HY < 3 | The ratio debt-household income is higher than zero and lower than three |
| | Debt/HY >= 3 | The ratio debt-household income is higer or equal to three |
| Credit constraints | Credit constraints | Dummy taking value 1 when the household has credit constraints |
| Risk aversion | Risk aversion | Dummy taking value 1 when the household is risk averse |
| Number of adults working | Nº of adults working | Number of adults belonging to the household that are currently working. Three categories: |
| | One adult working | Only the reference person works |
| | Two adults working | There are two persons working in the household |
| | Three or more adults working | There are three or more persons working in the household |
| Minors | Minors | Dummy taking value 1 when there are one or more children in the household |
| Employee and self-employee | Employee & self_employed | Dummy taking value 1 when the reference person is also self-employed |
| Age | Age | Age of the reference person |
| Gender | Man | Dummy taking value 1 when the reference person is a man |
| Married or like the facto partner | Couple | Dummy taking value 1 when the reference person is married or like the facto partner |
| Educational level | Education | The highest educational level reached by the reference person. A dummy for each level: |
| | Primary education | Primary education |
| | Secondary education | Secundary education |
| | College | College |
| **Negative expectations about future household income** | **Negative Y expectations** | Dummy taking value 1 when the household thinks that its future income will be lower than current income |
| **Expectations about losing the job in the next twelve months** | **Losing job** | Dummy taking value 1 when the reference person thinks that he/she will lose his/her job in the next twelve months |
| **Probability of losing the job in the next twelve months** | **p2 of losing job** | Square of the probability assigned by the reference person to the posibility of losing his/her current job in the next twelve months |
| **Variance of expected labor income** | **Variance of expected labor Y** | Variance of expected labor income of the reference person from the subjective probabiliy of losing his/her job |
| **Unemployment rate** | **Un rate** | Unemployment rate assigned to the household reference person according with the five-year age group and the gender to which belongs to from the LFS microdata |
| **Job insecurity indicator** | **Job insecurity indicator** | Job insecurity indicator according with the characteristics the reference person has in his/her job |

Own elaboration. Notes: * Categories according with the thresholds established by the Bank of Spain in calculating measures of debt burden of households with outstanding debts in its document: "Encuesta Financiera de las Familias (EFF) 2008: métodos, resultados y cambios desde 2005" (Banco de España, 2011).

TABLE A2. Sample characteristics. Households whose reference person is employee

| | | 2008 | | | | 2011 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Mean** | **Std. Dev.** | **Min.** | **Max.** | **Mean** | **Std. Dev.** | **Min.** | **Max.** |
| **Household** | Consumption | 17054.9 | 10401.8 | 3222.3 | 58001.4 | 16933.39 | 12356.4 | 3360 | 78000 |
| | Real wealth | 442227.0 | 616875.1 | 0 | 3974170 | 511908.9 | 1074711.0 | 0 | 9214000 |
| | Financial wealth | 79394.0 | 214674.2 | 0 | 1616521 | 168843.2 | 583921.7 | 0 | 4657000 |
| | Debt | 46535.1 | 76025.9 | 0 | 416750.8 | 52650.81 | 90022.1 | 0 | 562000 |
| | Debt/HY | 0.743 | 0.674 | 0 | 2 | 0.755 | 0.674 | 0 | 2 |
| | ln(C) | 9.576 | 0.586 | 8.078 | 10.968 | 9.539 | 0.613 | 8.120 | 11.264 |
| | ln(RW) | 11.177 | 4.143 | 0.000 | 15.195 | 11.387 | 3.760 | 0.000 | 16.036 |
| | ln(FW) | 9.266 | 2.614 | 0.000 | 14.296 | 9.574 | 2.704 | 0.000 | 15.354 |
| | Credit constraints | 5.51% | 0.228 | * | | 7.49% | 0.263 | * | |
| | Risk aversion | 76.56% | 0.424 | * | | 78.50% | 0.411 | * | |
| | Number of adults working | 1.688 | 0.623 | 1 | 3 | 1.654 | 0.626 | 1 | 3 |
| | Minors | 43.44% | 0.496 | * | | 43.03% | 0.495 | * | |
| **Reference person** | Employee and self-employee | 2.33% | 0.151 | * | | 2.93% | 0.169 | * | |
| | Income | 27261.6 | 21147.0 | 0 | 129360 | 32160.7 | 31730.9 | 0 | 200496.9 |
| | ln(Y) | 9.798 | 1.547 | 0.000 | 12.067 | 9.904 | 1.503 | 0.000 | 12.067 |
| | Age | 46.716 | 9.907 | 21 | 79 | 48.124 | 9.989 | 19 | 82 |
| | Man | 56.29% | 0.496 | * | | 59.90% | 0.490 | * | |
| | Married or the facto partner | 67.79% | 0.467 | * | | 67.86% | 0.467 | * | |
| | Primary education | 15.26% | 0.360 | * | | 14.00% | 0.347 | * | |
| | Secundary education | 47.20% | 0.499 | * | | 45.72% | 0.498 | * | |
| | College | 37.54% | 0.484 | * | | 39.86% | 0.490 | * | |
| **Uncertainty measures∇** | **Negative expectations about future household income** | 0.135 | 0.342 | * | | 0.288 | 0.453 | * | |
| | **Expectations about losing the job in the next twelve months** | 0.071 | 0.257 | * | | - | - | - | - |
| | **Probability of losing the job in the next twelve months** | - | - | - | - | 0.133 | 0.238 | 0 | 1 |
| | **Variance of expected labor income** | - | - | - | - | 9.277 | 9.737 | 0.000 | 44.254 |
| | **Unemployment rate** | 8.56% | 0.0219774 | 0.94% | 17.73% | 16.66% | 0.0385527 | 1.94% | 68.86% |
| | **Job insecurity indicator** | 2.941 | 0.663 | 2.117 | 5.467 | 2.902 | 0.689 | 2.117 | 5.750 |
| | **Sample size** | **1844** | | | | **1671** | | | |

Own elaboration from the EFF2008 and EFF2011 data. Economic variables are expressed in 2011 euros. ∇ Uncertainty measures refer to the reference person except Negative expectations about future household income, which refer to the whole household. (*) Dummy variables taking values 0 or 1.

# Appendix B. Chapter 3

Table B1. Brief description of the variables used in the analysis

| VARIABLE | VARIABLE NOTATION | BRIEF DESCRIPTION |
|---|---|---|
| Normal household income † | $\bar{Y}$ | Average income of the household over the period 2007-2014 |
| Standard deviation of income † | $SDY$ | Standard deviation of the household income |
| Non-durable consumption † | $C$ | Annual non-durable consumption of the household in 2014 |
| Ratio consumption – normal income | $C/\bar{Y}$ | Ratio between non-durable consumption of the household in 2014 and the average household income over the period 2007-2014 |
| Financial Wealth † | $FW$ | Financial wealth |
| Real Wealth † | $RW$ | Real wealth |
| Debt † | $debt$ | Debt value |
| Credit constraints* | Credit constraints | Dummy taking value one when the household has credit constraints |
| Risk aversion** | Risk aversion | Dummy taking value one when the household is risk averse |
| Family size | Family size | Household size in 5 categories: 1, 2, 3, 4 and 5 or more members |
| Number of children | Number of Children | Number of children in the household (under 18 years) |
| Income is under a threshold defined as the 20% of the average income of the period in some year | Household income under the 20% of $\bar{Y}$ | Variable collecting if the household income was/is under the 20% of $\bar{Y}$ |
| | $Y_t$> 0.2$\bar{Y}$ in all years | Current income over $0.2\bar{Y}$ in all years |
| | $Y_t$< 0.2$\bar{Y}$ in at least one year before 2014 | Current income lower than $0.2\bar{Y}$ in at least one of the previous years |
| | $Y_t$< 0.2$\bar{Y}$ in 2014 | Current income lower than $0.2\bar{Y}$ in 2014 |
| Age ‡ | Age | Age |
| Educational level ‡ | Primary education | Highest educational level reached: None studies or Primary education |
| | Lower Secondary education | Highest educational level reached: Lower Secondary education |
| | Upper Secondary education | Highest educational level reached: Upper Secondary education and First stage of Tertiary education (Vocational training) |
| | College | Highest educational level reached: Tertiary education and Doctoral studies |

Notes: † All these variables are in logarithm in the consumption regression, notation: $\mathrm{Ln}(\mathrm{variable})$
‡ These variables refer to the reference person.
* The variable is generated from the answer they give to some questions in the survey We understand that the household has credit restrictions when:
A) have been denied a loan to them, B) have been granted a loan for an amount less than that they requested or C) they have not requested any loan because they believe it would not be granted. This definition is the same used by Jappelli et al. (1998) in their first indicator of liquidity constraints.
** It is a self-reported variable by the household. The household has risk aversion when the answer they give to the question about "*the amount of financial risk the households are willing to run when they make an investment" is that "they are not willing to take on financial risk*".

Table B2. Average, Median and Standard Deviation of the variables included in the analysis

| | Average | Median | Standard Deviation |
|---|---|---|---|
| $C$ | 22319.42 | 16494.20 | 19117.51 |
| $\bar{Y}$ | 59073.39 | 35814.02 | 71547.79 |
| $C/\bar{Y}$ | 0.522 | 0.479 | 0.279 |
| $SDY$ | 28955.44 | 11962.72 | 45623.43 |
| $FW$ | 2.74E+05 | 28646.8 | 8.59e+05 |
| $RW$ | 6.90E+05 | 2.28E+05 | 1.44e+06 |
| $Debt$ | 28816.77 | 0 | 68688.86 |
| $Ln(C)$ | 9.765 | 9.711 | 0.675 |
| $Ln(\bar{Y})$ | 10.555 | 10.486 | 0.881 |
| $Ln(SDY)$ | 9.474 | 9.39 | 1.249 |
| $Ln(FW)$ | 9.882 | 10.254 | 2.999 |
| $Ln(RW)$ | 11.926 | 12.336 | 3.039 |
| $Ln(debt)$ | 3.908 | 0 | 5.102 |
| Credit constraints | 8.60% | - | 0.281 |
| Risk aversion | 0.817 | - | 0.387 |
| Family size | 2.498 | 2 | 1.160 |
| Number of children | 0.320 | 0 | 0.677 |
| $Y_t > 0.2\bar{Y}$ all years | 93.73% | - | - |
| $Y_t < 0.2\bar{Y}$ in at least one year before 2014 | 4.54% | - | - |
| $Y_t < 0.2\bar{Y}$ in 2014 | 1.73% | - | - |
| Age | 62.77 | 64.0 | 13.70 |
| Primary education | 33.40% | - | 0.472 |
| Lower Secondary education | 13.30% | - | 0.339 |
| Upper Secondary education | 23.20% | - | 0.422 |
| College | 30.18% | - | 0.459 |
| Sample size | 1524 households | | |

*Notes*: all the variables refer to the 2014 year, since is the one in which we analyse the existence and strength of precautionary saving. Economic variables are in 2014 euros. The demographic individual variables refer to the household reference person. *Source:* EFF panel data (balanced panel using 2008, 2011and 2014 waves).

TABLE B3. The uncertainty effect on household non-durable consumption in 2014: estimation results for the panel from 2005 to 2014

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | $ln(Cons)$ | $ln(Cons)$ | $Cons\ /\ \bar{Y}$ | $Cons\ /\ \bar{Y}$ |
| Ln($\bar{Y}$) | 0.408*** | 0.516*** | -0.233*** | -0.193*** |
| | (0.030) | (0.045) | (0.018) | (0.026) |
| Ln(SDY) | | -0.079*** | | -0.029** |
| | | (0.025) | | (0.013) |
| Ln(FW) | 0.023*** | 0.020*** | 0.007 | 0.006 |
| | (0.007) | (0.007) | (0.005) | (0.005) |
| Ln(RW) | 0.004 | 0.003 | -0.002 | -0.002 |
| | (0.006) | (0.006) | (0.005) | (0.005) |
| Ln(debt) | 0.029*** | 0.029*** | 0.012*** | 0.012*** |
| | (0.003) | (0.003) | (0.002) | (0.002) |
| Credit constraints | 0.009 | 0.012 | 0.029 | 0.030 |
| | (0.050) | (0.050) | (0.034) | (0.034) |
| Risk aversion | -0.135*** | -0.132*** | -0.054*** | -0.053*** |
| | (0.040) | (0.040) | (0.019) | (0.019) |
| Family size | 0.102*** | 0.097*** | 0.035*** | 0.034*** |
| | (0.018) | (0.018) | (0.008) | (0.008) |
| Number of children | -0.018 | -0.017 | -0.002 | -0.001 |
| | (0.026) | (0.026) | (0.013) | (0.013) |
| Age | 0.008*** | 0.007*** | 0.004*** | 0.004*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Primary education | -0.087** | -0.082** | -0.023 | -0.021 |
| | (0.042) | (0.041) | (0.025) | (0.025) |
| Upper secondary education | -0.000 | -0.007 | -0.004 | -0.006 |
| | (0.043) | (0.042) | (0.022) | (0.022) |
| College | 0.099** | 0.086* | 0.046* | 0.041* |
| | (0.047) | (0.047) | (0.024) | (0.024) |
| 1. $Y_t$<0.2$\bar{Y}$ in at least one year before 2014 | -0.016 | 0.035 | 0.016 | 0.034 |
| | (0.058) | (0.059) | (0.029) | (0.029) |
| 2. $Y_t$<0.2$\bar{Y}$ in 2014 | -0.201 | -0.150 | -0.045 | -0.026 |
| | (0.146) | (0.144) | (0.048) | (0.049) |
| _cons | 4.434*** | 4.108*** | 2.595*** | 2.473*** |
| | (0.271) | (0.288) | (0.122) | (0.136) |
| r2_a | 0.6415 | 0.6453 | 0.3695 | 0.3724 |
| N | 876 | 876 | 876 | 876 |

*Notes:* Coefficient estimates. Cluster robust standard errors in parentheses. Significance levels: *** p<0.01 ** p<0.05 * p<0.10. Economic variables are in 2014 euros. (Factors for 2004 and 2005 are 1.2209 and 1.1770, respectively).